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FINAL REPORT

Environmental Study of
the Barrier and Bay Island Communities

Town of Babylon, New York

Submitted to:
Town of Babylon
Lindenhurst, New York 11757

June 1994

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SUMMARY

EXECUTIVE SUMMARY

S.1 SCOPE AND PURPOSE

This report presents the findings of a detailed environmental study of the residential communities on the barrier and bay islands (i.e., the "Outer Beach") within the Town of Babylon, Suffolk County, New York. The study area comprises six separate communities (West Gilgo Beach, Gilgo Beach, Captree Island, Oak Island, Oak Beach, and the Oak Beach Association), as well as the immediately adjacent areas. All six of the subject communities are situated on lands that are owned by the Town of Babylon, and which are leased by the Town for the express purpose of allowing residential occupancy.

This study was commissioned as part of the settlement of litigation initiated by the State of New York in response to the Town's extension of the residential leases on the barrier and bay islands. An Advisory Committee, consisting of representatives from the State, the beach communities, and Suffolk County Planning Departmentwas created to oversee this project. The scope of work for this study was established by the Advisory Committee.

The study elements included in the final scope of work for this investigation are as follows:

1) surface water and groundwater quality
2) erosion control and flooding
3) interaction with natural systems
4) development potential
5) community costs and benefits
6) homeowner equity
7) public access and recreational usage

S.2 METHODS

The subject investigation entailed a combination of the collection and analysis of new data, analysis of existing data, telephone interviews and meetings with individuals having pertinent knowledge, and review of applicable scientific reports and similar documents. New information was generated through numerous field surveys, which included identification and measurement of the following:

- grade and first floor elevations of houses in the subject communities
- location, type, and condition of shore protection structures in and adjacent to the communities
- heights and the condition of the oceanfront dunes along Ocean Parkway in the Town of Babylon
- location and spatial extent of dunes that have been disturbed by pedestrian traffic in the vicinity of the communities

- spatial extent of vegetation disturbed by development in the study area
- spatial extent of disturbed tidal wetland areas in the study area
- tidal wetland zones, based on information contained in the official tidal wetland maps
- spatial extent of escaped ornamental plant species in the study area
- development constraints (e.g., wetlands, coastal erosion hazard areas) pertaining to presently vacant lots within the communities
- location and condition of points of public access to the waterfront in the study area

A questionnaire was formulated to obtain information directly from the residents of the Outer Beach communities concerning a variety of pertinent topics. A total of 331 completed questionnaires were received from residents in the study area, out of a total 415 houses (an 80 percent rate of response). Data analysis was performed on microcomputer (see Appendix A).

S.3 FINDINGS

Overall, the six subject communities have not had large scale adverse impacts on the barrier and bay island environment. Although, clearly there have been some negative effects of the development of the Outer Beach, the existence of this development has also generated some benefits. The following is a synopsis of the primary findings of this investigation, with respect to each of the study elements.

1) <u>surface water and groundwater quality</u> - There is no evidence that the Outer Beach communities have caused significant deterioration of the quality of surface waters in the surrounding area.

   Septic effluent released from the subject residences via subsurface sewage disposal systems has adversely affected groundwater quality in the upper portion of the aquifer. However, contaminants do not penetrate to the drinking water resources of the deep aquifer, due to the presence of a salty groundwater layer that separates the shallower and deeper layers of freshwater. The presence of residential development on the Outer Beach has likely caused some penetration of saltwater into the deep aquifer due to infiltration of salty groundwater through the deteriorating casings of abandoned wells.

2) <u>erosion control and flooding</u> - The potential for damage caused by a severe coastal storm is the most serious threat that faces the residents and property of the Outer Beach. The six residential communities lie entirely within the designated boundary of the 100-year flood plain, and fully 81 percent of the individual houses are situated within the V zone, which is susceptible to significant wave action during the 100-year storm. However, only 42 percent of the houses in the study area conform with the minimal flood prevention standard for first floor elevation, and it is estimated that fewer

than 5 percent of the houses in the V zone comply with strict structural requirements for resistance against wind and storm waves.

At the present time, the communities at West Gilgo and Gilgo Beaches are especially vulnerable due to the substantial loss of beach and dune material caused by recent storms. The Oak Beach communities are, similarly, more susceptible to storm damage than ever before due to the recent deterioration of the Sore Thumb. However, whereas it is likely that all feasible action will be implemented to restore the West Gilgo and Gilgo shorelines due to the overriding urgency of protecting Ocean Parkway and preventing the formation of a new inlet, no such priority has been applied to the restoration of the Sore Thumb. As a result, it is possible that necessary maintenance of the Sore Thumb will never be undertaken. With the diminishing ability of the Sore Thumb to deflect tidal currents away from Oak Beach, the communities at that location will likely experience accelerated shoreline erosion and increasing susceptibility to storm-induced damage.

Despite the potential for the subject communities to incur significant damage due to severe coastal storms, very little damage has actually been sustained in recent memory. In fact, the residences in the study area have escaped virtually unscathed from recent storms which have wreaked extensive destruction in other areas of Long Island. This may give some residents a false sense of security regarding their susceptibility to coastal storms, which increases the likelihood that some residents will not react appropriately to official directives during a storm emergency. The possible consequences of such a situation would be increased property damage, and unnecessary injuries and even deaths.

3) <u>interaction with natural systems</u> - The subject residential communities are not causing any major impacts to the natural systems of the Outer Beach. Several minor impacts have occurred, including: the removal of native plants and replacement with buildings, pavement, and landscaping vegetation (including Japanese black pine) within the residential communities; the loss of native habitat within the developed areas of the communities due to the removal of indigenous vegetation; the localized spread of typically ornamental species from the communities to the adjacent dune and beach areas; the destruction of dune plant species due to concentrated foot traffic along paths that traverse the dunes; increased outdoor populations of cats and dogs, which can disturb shore bird nesting areas; and the mowing of wetland vegetation in some communities. However, these impacts are balanced by certain ecological benefits that are derived from the presence of humans on the Outer Beach (which are summarized in Section S.4) and, consequently, the overall effect does not appear to be either strongly detrimental or beneficial.

4) development potential - The study area and vicinity contains large tracts of vacant land, including approximately 82 building lots within the subject communities that are designated for residential use and which are potentially developable. The construction of houses on these properties would result in a significant increase in the number of residents in the study area and a concomitant increase in the level of impact caused by the subject communities. Alternatively, the total lot count on the Outer Beach can be maintained at a maximum of 415, and the vacant lots can be held in reserve for the relocation of existing homes from sites that are more susceptible to storm damage.

5) community costs and benefits - The cost-benefit analysis performed as part of this study indicates that the Town of Babylon presently receives a significant net monetary benefit from the subject communities. This benefit will increase as the annual rental fee escalates during the term of the current leases. The Town would likely incur substantial direct and indirect relief costs in the event of a coastal storm that causes substantial damage to the subject communities. Thus, the assessment of positive financial impacts would have to be re-evaluated if large-scale, storm-induced structural damage were to occur.

6) homeowner equity - The current leases have a term that extends to the year 2050. The Town has the authority to terminate the leases prematurely, but only if the tenants are provided just compensation in accordance with the terms of the leases. This compensation, which would include house-moving expenses and remuneration for the loss of the use of the property, could be prohibitive, especially if action is undertaken early in the lease term. The Town's costs would become lower as termination is effected nearer to the lease expiration date; however, the potential benefits of lease termination would also diminish. Thus, it appears that the potential benefits that would be derived from premature lease termination would not justify the costs that would be applied to the Town, even without considering the possible legal costs in the likely event of a breach of contract suit by the residents.

7) public access and recreational usage - There currently is no demonstrated need for the creation of additional recreational facilities in the vicinity of the subject communities, nor is it apparent that this need will arise in the foreseeable future. Even if it was determined that additional land was needed for park land expansion, none of the lands within the subject communities would provide an ocean beach, which is the type of facility that is in greatest demand. Despite the fact that the subject communities occupy public land, the existence of these communities does not appear to be limiting opportunities for public recreation and the enjoyment of open space.

S.4 BENEFICIAL ENVIRONMENTAL EFFECTS OF THE SUBJECT COMMUNITIES

The presence of the subject communities appears to be providing indirect environmental benefits to the barrier and bay islands. In general, residents of the study area have a high level of appreciation for the Outer Beach environment. The resident survey conducted as part of this investigation revealed that fully 60 percent of the residents engage in conservation activities, which include: debris cleanups; annual roping of habitat areas for protected shorebirds; sand fence placement; beach grass planting; tree planting; installation of osprey nesting platforms; field education programs; placement of Christmas trees along the dunes at Gilgo Beach; financial support and coordination with the Town for a storm drain stencilling program; voluntary collection of mosquito larvae samples from local marshes; and various other activities. In addition, 60 percent of the respondents to the homeowner survey indicated that they provide food to local wildlife, including birdhouses, plantings that provide food (such as berry bushes and corn/grain plants), feed for mammals (such as corn grain, nuts and hay), and bread placed out for waterfowl.

S.5 MITIGATION MEASURES

The following is a listing of the primary measures that have been formulated to mitigate the environmental impacts of the subject communities.

- The number of residences in the study area should be frozen at no more than its current level of 415. The Town Board should explore legal mechanisms to ensure that this policy is retained.

- No construction activity should be permitted in the study area which involves the direct discharge of stormwater to surface waters or tidal wetlands. Leaching pools should be required whenever an action will result in a potential increase in the long-term discharge of stormwater to surface waters or tidal wetlands.

- All activities within the subject communities should be undertaken so as to maintain or enhance the existing vegetative buffer areas.

- Permeable surfaces should be required for all new paved areas within the subject communities that are 300 feet or less from a surface water body or tidal wetland.

- Appropriate sediment and erosion control measures should be implemented for all activities within the subject communities that will result in exposed soils that can potentially be carried to nearby surface waters or wetlands.

- Boaters in the subject communities (as well as transient boaters who visit the area) should be made aware of the locations of wastewater pumpout stations in the vicinity of the study area.

- Where possible, private homeowner wells used for potable water supply should be replaced with year-round community supply systems that service more than 5 residences.

- Private wells in the study area, which presently are not subject to any monitoring requirements subsequent to the mandatory pre-installation testing, should be monitored on a routine basis to ensure acceptable water quality.

- There should be increased governmental monitoring of the closure of private wells in the study area, which would prevent these wells from becoming a conduit for the downward migration of saltwater and other contaminants. Enhanced oversight of the installation of new private wells would ensure that these wells meet minimum standards of construction, which would prolong their life and decrease the rate at which wells are abandoned in the future.

- Appropriate measures should be implemented to eliminate the use of shallow wells for drinking water supply in the study area. This problem pertains to a small percentage of homes in Gilgo Beach and the Oak Beach Association, as revealed by the responses to the homeowner survey. Mitigation might include a suitable public education program regarding the possible health consequences of drinking water from the shallow aquifer and the need to use bottled water for human consumption, and possibly connection to existing deep wells or the installation of new deep wells. Shallow wells can continue to be used for non-potable water.

- Hurricane preparedness education should be stepped up and provided on an annual basis to residents of the subject communities. It is recommended that a pamphlet be designed to serve the multiple purposes of increasing public cognizance of the study area's susceptibility to severe coastal storms (particularly hurricanes) and instructing residents on steps to take in the event of an impending storm.

- In an effort to increase the level of flood insurance coverage, the Town should distribute pertinent educational materials to the affected residents to explain the objectives of the National Flood Insurance Program, and should highlight the advantages of having flood insurance versus other possible means of disaster relief. Although the homeowner survey indicated that flood insurance policies are in effect for approximately 61 percent of the houses on the Outer Beach, which is much higher than was expected from earlier discussions with agency officials, there is still a substantial number of properties that do not have such coverage.

- The Town should maintain its commitment to participating in the Community Rating System of the National Flood Insurance Program, and should investigate options for expanding its level of participation. For example, the availability of sources of revenue to fund the conversion of existing houses to meet FEMA requirements should be pursued.

- Beach nourishment and dune restoration activities along West Gilgo and Gilgo Beaches should be continued into the indefinite future. The State's mechanism for obtaining the funding to support their share of the costs of the Fire Island Inlet dredging/beach nourishment project should be reviewed and strengthened, if possible, through legislation that <u>requires</u> dredge spoil from the inlet to be used for beach nourishment purposes.

- Mechanisms for funding the restoration of the Sore Thumb should be investigated.

- The Town's Coastal Erosion Hazard Area (CEHA) legislation should be strengthened to specifically prohibit the reconstruction of substantially damaged houses located in the CEHA.

- The environmental review process for the replacement of existing houses on the Outer Beach with new construction should be streamlined to the maximum extent possible without sacrificing the "hard look" required under the State Environmental Quality Review Act.

- A more vigorous dune management plan should be implemented, which includes: increased signage and fencing to direct traffic away from unprotected dunes, construction of walkways at strategic locations over the dunes, intensified enforcement of the existing ban on foot traffic across the dunes, and a redoubled public education effort.

- Water craft speed limits through the State Boat Channel in the vicinity of the Captree Island community should be vigorously enforced to minimize wake-induced shoreline erosion.

- The Town should investigate and implement means of shifting the beach-going population from the heavily utilized facility at Gilgo Beach to the two currently underutilized facilities at Overlook and Cedar Beaches.

- The Town of Babylon should further investigate the need for additional public dock space. If a real need exists, the Town should explore alternatives for increasing the number of public boat slips through the expansion of existing public facilities, the re-establishment of presently abandoned facilities that had been utilized in the past, and the conversion to public use of private yacht clubs that currently occupy land leased from the Town.

S.6 MANAGEMENT RECOMMENDATIONS

The following is a summary of the primary management recommendations of this study.

1) Community Associations - Homeowners' associations should be established in the three communities (i.e., Gilgo Beach, Captree Island, and Oak Beach) which are presently unassociated. The existence of a community association appears to afford a greater degree environmental protection than exists in the absence of such an organization.

2) Development Intensity - The estimated 82 vacant lots that are considered to be developable should be reserved for the relocation of existing houses from areas which are most susceptible to coastal storm damage or which sit in or adjacent to important habitat areas. This policy should be implemented without increasing the total number of houses in the subject communities above a maximum of 415.

3) Public Environmental Awareness Education - Enhanced public education should be an important component of any management plan to minimize the overall impact of the subject communities.

4) Management of the Gilgo/West Gilgo Oceanfront - The storm protection afforded the Gilgo and West Gilgo Beach communities is dependent upon the continuation of beach nourishment and dune restoration activities along the adjacent oceanfront beaches. In the event of the discontinuation of these projects (or the failure of these projects to achieve their objectives), resulting in the loss of Ocean Parkway to storm damage, amended management strategies for this portion of the barrier island should be formulated.

5) Management of the Coastal Erosion Hazard Area (CEHA) - It is expected that the CEHA regulations promulgated by the Town of Babylon will be applied to prohibit the restoration of houses that are substantially damaged during a coastal storm. This management strategy appears to be sound. The destruction of houses within the CEHA by storms would confirm that this area is prone to such damage, and the in-place restoration of such houses would not be consistent with prudent environmental planning. However, the removal of CEHA houses for reasons other than storm-induced damage (e.g., fire damage) would not be tied directly to an established relationship between the structure's presence in the CEHA and its susceptibility to storm damage and, therefore, would not be supported by the findings and conclusions of this study.

SECTION 1

SECTION 1
INTRODUCTION

SECTION 1

INTRODUCTION

1.1 DESCRIPTION OF STUDY AREA

This report presents the findings of a detailed environmental study of the barrier and bay island communities within the Town of Babylon, Suffolk County, New York. In accordance with the project's required scope of work, this study focuses on the residential communities that are present on the barrier and bay islands within the Town of Babylon (Figure 1-1). The adjacent area, which consists mostly of recreational facilities, vacant land, and surface waters, is also examined in this report, but only to the extent that is warranted by the objectives of the study (see Section 1.3). The relatively small number of commercial uses on the Town of Babylon barrier and bay islands (e.g., the Oak Beach Inn, the Gilgo Inn, and Frank and Dick's fueling dock) were not included in the scope of the study.

The Town of Babylon's barrier and bay islands are collectively called the "Outer Beach". Residential development in this area is confined to six distinct communities, which are shown in Figure 1-2 and are listed below:

West Gilgo Beach	Captree Island
Gilgo Beach	Oak Beach (unassociated)
Oak Island	Oak Beach Association

All six of the subject communities are situated on lands that are owned by the Town of Babylon, and which are leased by the Town for the express purpose of allowing residential occupancy. In Gilgo Beach, Captree Island, and the unassociated portion of Oak Beach, the leases have been drawn up directly between the Town and the homeowners. Each of the other three communities (i.e., West Gilgo Beach, Oak Island, and the Oak Beach Association) is represented by a homeowners' association, to which the Town leases the entire community's land, and subleases transfer the usage rights for individual lots to the residents.

1.2 STUDY BACKGROUND

Background information is presented below to summarize the primary events which directly led to the initiation of this study. This discussion is a synopsis of pertinent aspects of the complex history of issues and conflicts that have arisen with respect to the presence of residential development on the Town of Babylon's barrier and bay islands.

In 1990, the Babylon Town Board granted an extension of the leases for the residential use of Town-owned land on the Outer Beach. These leases, which were scheduled to expire in various years around the turn of the century, were collectively extended to the year 2050. The State of New York, which had previously expressed objections to the long-term renewal of these leases, commenced a legal action in the Supreme Court of the State of New York to have the lease extensions invalidated. The State's lawsuit was based primarily on the contention that the Town of Babylon did not comply with the requirements of the State Environmental Quality Review Act (SEQRA) when the leases were extended. The Town of Babylon, the Town Board, the Town Supervisor, and the three homeowners' associations in the subject communities were all named as respondents in this action.

In an effort to avoid the commitment of manpower and money that would have been required by a protracted legal battle, a settlement was reached which terminated the lawsuit. As part of this settlement, the parties agreed to undertake an environmental study of the six outer beach communities and the surrounding area. The Outer Beach residents were responsible for providing 50 percent of the cost of the study, while the remaining 50 percent was to be provided by the State.

An Advisory Committee was established to implement the scope of analysis for the environmental study, to evaluate qualifications and proposals submitted in response to the Town of Babylon's Request for Qualifications (RFQ) and Request for Proposals (RFP), to select a consultant to undertake the study, to oversee the preparation of a scientific report of the findings of the study, and to evaluate the contents of the report. The Advisory Committee is chaired by the Babylon Town Supervisor and consists of representatives of the New York State Department of State, New York State Department of Environmental Conservation, the Suffolk County Planning Department, and residents of the communities that are the subject of the investigation. On the basis of a review of proposals that were submitted to the Town, in conjunction with follow-up interviews, Cashin Associates, P.C. (CA) of Hauppauge, New York was selected as the consultant for this project. Work on the study was initiated at a meeting that was held between the Advisory Committee and Cashin Associates, on August 20, 1992. The scope of work for the study is based on the Town's RFP and CA's proposal, dated July 10, 1992, prepared in response to the RFP.

1.3 SCOPE OF STUDY AND PROJECT OBJECTIVES

The scope of the environmental study was specified in a Request for Proposals (RFP) that was formulated by the Advisory Committee and was issued by the Town of Babylon through the Department of General Services. Seven individual study elements were identified in the RFP as being of primary concern to members of the Advisory Committee. Other issues that were discussed during the scoping meetings of the Advisory Committee were deleted from the final scope so that the study could concentrate on the key issues facing the study area, as identified and agreed to by the Advisory Committee.

The study elements included in the final scope of work for this investigation are as follows:

1) surface water and groundwater quality
2) erosion control and flooding
3) interaction with natural systems
4) development potential

5) community costs and benefits
6) homeowner equity
7) public access and recreational usage

The objectives of this investigation with respect to each of the seven study elements are discussed in Sections 1.3.1 through 1.3.7 below.

Several other issues initially identified by the Advisory Committee but not included in the final scope were incorporated into the study because of their association with the primary study elements. For example, the Fire Island Inlet navigation project and the effect of sea level rise on flooding and erosion were two of the topics that were considered for inclusion in the investigation, but were not incorporated into the Committee's final scope of seven study elements. However, since the inlet dredging project is intimately tied to storm erosion mitigation activities in the study area, this subject was investigated in-depth and is discussed at length in this report (see Section 4.1.5). Additionally, it was determined that the purposes of this study would not be fully served by ignoring the issue of sea level rise and, consequently, a discussion is presented to address this issue within the context of the Barrier and Bay Island Study (see Section 4.7).

1.3.1 STUDY ELEMENT 1 - SURFACE WATER AND GROUNDWATER QUALITY

The primary objectives of the investigation performed under this study element were:

- to compile information and data concerning surface and groundwater quality in the study area, which will serve as a baseline for future evaluation of these parameters;
- to determine if the subject barrier and bay island communities have had a significant effect on the quality of surface water and groundwater in the area; and
- to identify feasible measures available to the Town, other government agencies, and the homeowners to mitigate the impacts of long-term surface and groundwater degradation.

1.3.2 STUDY ELEMENT 2 - EROSION CONTROL AND FLOODING

The primary objectives of the investigation performed under this study element were:

- to compile information concerning coastal erosion and storm flooding that has occurred in the study area;
- to compile information regarding measures that have been used to mitigate coastal erosion and storm flooding in the study area;

- to assess the vulnerability of the land and structures in the study area to storm-induced erosion and flooding;
- to determine if the development of the subject barrier and bay island communities has had a significant effect on the extent of coastal erosion and flooding that has occurred in the local area; and
- to identify feasible measures available to government agencies and the homeowners to mitigate the impacts of long-term erosion and flooding.

1.3.3 STUDY ELEMENT 3 - INTERACTION WITH NATURAL SYSTEMS

The primary objectives of the investigation performed under this study element were:

- to compile baseline information on wildlife populations and vegetative communities within and adjacent to the study area;
- to identify the negative and positive impacts that residential development in the study area has had on the ecology of the barrier and bay islands; and
- to describe options for the management and preservation of important vegetative and wildlife communities within and adjacent to the study area.

1.3.4 STUDY ELEMENT 4: DEVELOPMENT POTENTIAL

The primary objectives of the investigation performed under this study element were:

- to compile information on the present pattern of land use within the barrier and bay island communities in the study area;
- to assess the potential for further development within the study area;
- to evaluate the effectiveness of present land use regulations in controlling development and curbing potential impacts;
- to assess the potential impacts of additional development/ redevelopment, including the conversion of existing seasonal units to year-round occupancy;
- to identify measures to ameliorate existing problems and to prevent potential impacts in the future.

1.3.5 STUDY ELEMENT 5 - COMMUNITY COSTS AND BENEFITS

The primary objectives of the investigation performed under this study element were:

- to compile an account of the expenditure of public funds and the generation of revenues associated with the barrier and bay island communities in the study area;
- to perform a cost-benefit analysis which provides a measure of current and future economic impact (positive or negative) resulting from the development of the barrier and bay islands; and
- to assess the historical economic impacts of storms on the subject communities, and to determine the cost effectiveness of mitigative measures that have been used.

1.3.6 STUDY ELEMENT 6 - HOMEOWNER EQUITY

The primary objectives of the investigation performed under this study element were:

- to evaluate mechanisms for providing equitable reimbursement to homeowners on the barrier and bay islands in the event that their lease agreements are prematurely terminated;
- to assess appropriate means of compensating homeowners if their lease agreements are not renewed upon expiration; and
- to evaluate means of generating the funds necessary to provide for homeowner reimbursement, as well as probable disbursement of costs.

1.3.7 STUDY ELEMENT 7 - PUBLIC ACCESS AND RECREATIONAL USAGE

The primary objectives of the investigation performed under this study element were:

- to compile an inventory of public access points (including established public recreational facilities and less formal points of access) within and in the vicinity of the study area;
- to determine the extent to which the existence of the subject residential communities may have reduced opportunities for public access to the waterfront;
- to project future demand for public recreation and access in the vicinity of the study area; and

- to assess the extent to which the overall use of the coastal zone in the vicinity of the study area conforms with State policies concerning recreation and public access.

1.4 STUDY METHODOLOGY

The subject investigation entailed a combination of the collection and analysis of new data, analysis of existing data, telephone interviews and meetings with individuals having pertinent knowledge, and research of applicable scientific reports and similar documents. The primary methodologies that were used in this study are discussed below.

1.4.1 FIELD INSPECTIONS

Numerous site visits were conducted during the course of this study to collect field data and to make miscellaneous observations (including the assessment of post-storm conditions). The dates of field work are listed as follows:

June 19, and September 8, 1992 - preliminary land-side surveys of the entire study area and vicinity

September 11, 1992 - water-side survey of the entire study area and vicinity

October 8, 9, 19, 22, 23, and 30, and November 17 and 19, 1992 - data collection surveys

September 25, and December 12 and 15, 1992 - survey of post-storm conditions related to Tropical Storm Danielle and the 10-12 December northeaster

Field research was conducted primarily by CA's staff ecologist, marine environmental scientist, and environmental planner, with the assistance of the Town of Babylon Department of Environmental Control. During the data collection surveys, information was gathered with respect a variety of parameters, including the following:

- measurement of the grade and first floor elevations of ±391 of the 415 houses within the study area;
- determination of the location, type, and condition of shore protection structures (i.e., bulkheads, revetments, groins, etc.) within the Outer Beach communities;
- assessment of the heights and the condition of the dunes along Ocean Parkway;
- determination of the location of areas of dunes that have been disturbed by pedestrian traffic;
- delineation of the boundary of the area of vegetation disturbed by development within the subject communities;

- determination of the location of disturbed tidal wetland areas;
- field verification of the boundaries of tidal wetland zones in the vicinity of the subject communities (based on information contained in the NYS Department of Environmental Conservation tidal wetland maps);
- delineation of the boundary of the area in which escaped ornamental plant species were found;
- preliminary assessment of the development potential of vacant lots within the subject communities, based on the presence of wetland vegetative species and other factors; and
- assessment of the location and condition of points of public access to the waterfront.

Methodologies that were used during the field work are discussed in the respective portions of the main text of the report, particularly in the sections on erosion control and flooding (Section 4) and ecology (Section 5).

1.4.2 PROGRESS MEETINGS

Progress meetings were held on a monthly basis during the course of the subject investigation. Progress reports were distributed to members of the Advisory Committee in advance of each meeting. These reports contained a summary of the work that was completed during the preceding month, the tasks that were scheduled for the upcoming month, and the problems and issues that surfaced since the previous meeting. The progress reports formed the basis of discussion at the meetings, and were helpful in generating comments from committee members.

1.4.3 RESIDENT SURVEY

A questionnaire was formulated to obtain information directly from the residents of the Outer Beach communities concerning a variety of pertinent topics. The contents of several draft versions of this document were reviewed by the Advisory Committee and discussed during the October 27 and November 24 progress meetings. The finalized survey questionnaire is included in Appendix A.

The survey questionnaires were delivered to the Outer Beach Residents' Ad Hoc Committee on November 10, 1992 and were subsequently mailed to residents by a designated individual within each community. The survey packet consisted of: a cover letter composed by the Ad Hoc Committee, which described the purpose of the survey and the importance of the survey information to the environmental study; and a copy of the two-page questionnaire (see Appendix A).

A total of 331 completed questionnaires were received from residents in the study area, with the breakdown of response by community as follows:

Community	Number of Residences	Number of Responses	Percent Response
West Gilgo Beach	80	53	66
Gilgo Beach	57	51	89
Oak Island	54	46	85
Captree Island	32	23	72
Oak Beach (unassociated)	120	86	72
Oak Beach Association	72	72	100
TOTAL (ALL 6 COMMUNITIES)	415	331	80

The data that were collected during the resident survey were transferred to a microcomputer spreadsheet program for analysis. The spreadsheet's sort command was used repetitively to determine the number of each given response for each question. Appendix A contains a discussion of the results.

1.4.4 USE OF EXISTING DATABASES

Whenever possible, existing databases were used to define environmental conditions in the study area and vicinity. For example, the surface water discussion (Section 2) relied heavily upon water quality data obtained from the NYS Department of Environmental Conservation and Suffolk County Department of Health Services; no new field data were generated under this study element. The groundwater discussion (Section 3) was based largely on data provided by the County Health Department and the U.S. Geological Survey and, likewise, no new field data were generated under this study element. The examination of flooding and erosion control issues (Section 4) was based on a combination of existing data (e.g., flood maps, flood insurance policy data, etc.) and field collection of new information. The analysis of ecological conditions (Section 5) was also drawn largely from existing data sources, although new data were collected as part of this study element as well. Refer to the respective sections of the text for a more detailed discussion of the extent to which existing data were used for each of the seven study elements.

1.4.5 PERSONAL COMMUNICATIONS

Due to the restricted time in which this study had to be completed, and because of the continually changing nature of the information related to some of the study elements (especially with respect to erosion control and flooding), written documents were not always available to provide necessary information for important aspects of the study. Consequently, a large amount of information presented in this report was obtained during informal meetings or telephone conversations with knowledgeable individuals. In order to facilitate follow-up inquiries, a diligent effort was made to properly document each such communication in the appropriate section of the text.

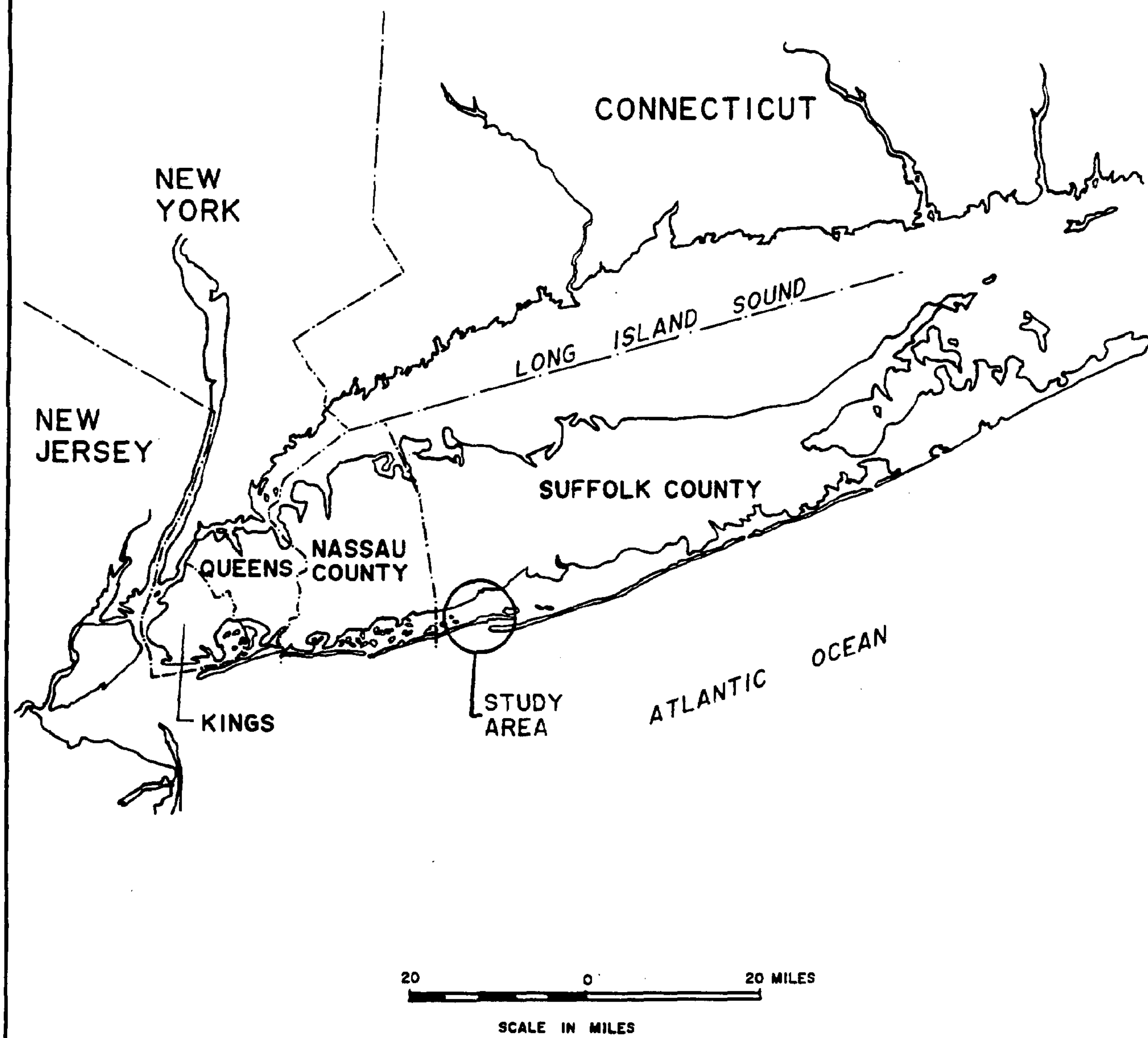
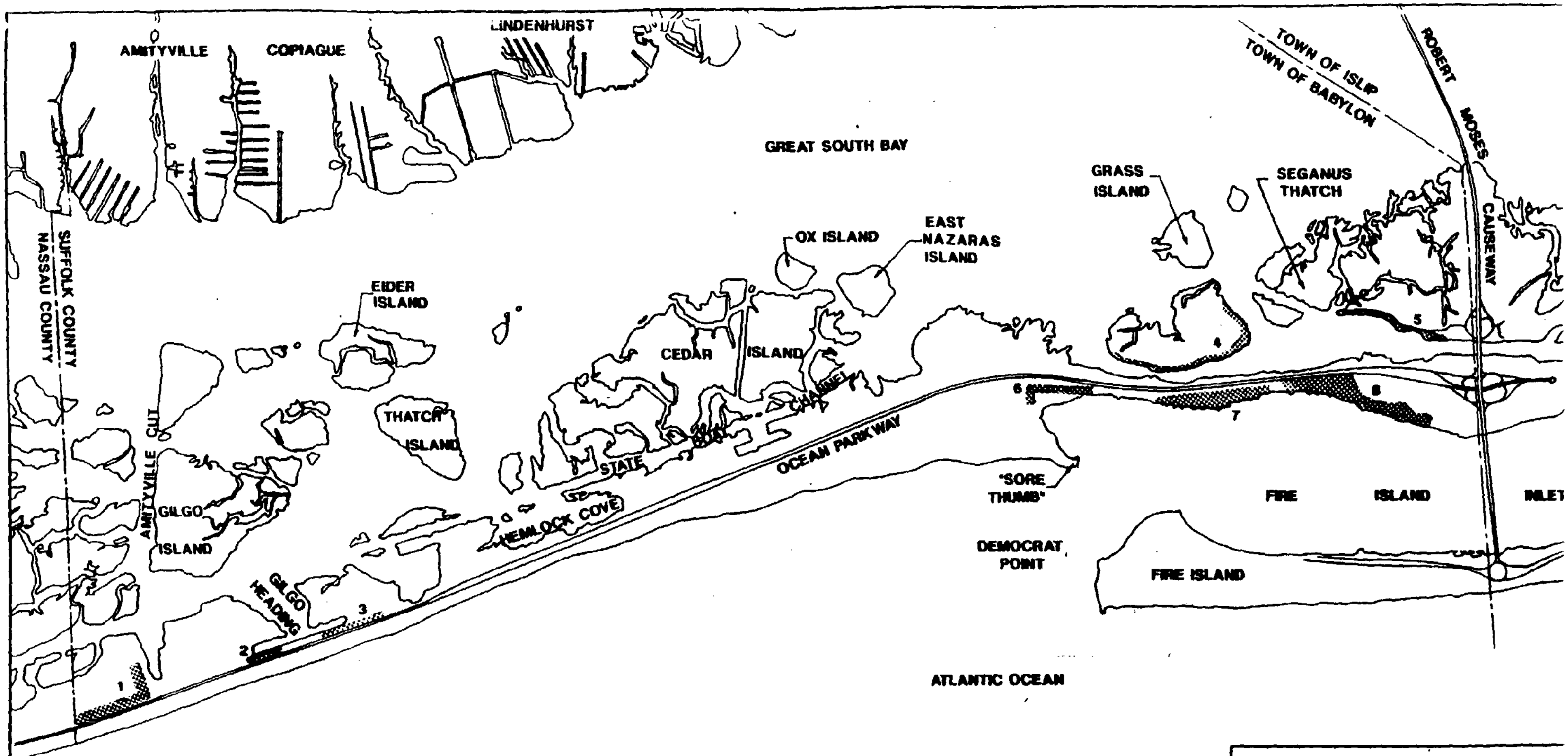


FIGURE 1-1 : LOCATION MAP

TOWN OF BABYLON ENVIRONMENTAL STUDY BARRIER & BAY ISLAND COMMUNITIES	Cashin Associates, P.C.



OUTER BEACH COMMUNITIES

1 WEST GILGO BEACH
2 GILGO BEACH WEST (UNASSOCIATED)
3 GILGO BEACH EAST (UNASSOCIATED)
4 OAK ISLAND
5 CAPTREE ISLAND (UNASSOCIATED)
6 OAK BEACH WEST (UNASSOCIATED)
7 OAK BEACH EAST (UNASSOCIATED)
8 OAK BEACH ASSOCIATION

FIGURE 1-2

STUDY AREA

TOWN OF BABYLON
ENVIRONMENTAL STUDY
BARRIER & BAY ISLAND COMMUN

Cashin Associates, P.C

SECTION 2
SURFACE WATERS

SECTION 2

SURFACE WATERS

2.0 INTRODUCTION

The study area is bordered immediately to the north by Great South Bay and its coves, leads, and other tributary water bodies. To the immediate south lie the Atlantic Ocean and Fire Island Inlet. Due to the proximity of these water bodies to the subject communities, the potential impact that these residential areas have on essential surface water resources is an important issue addressed in this study.

Water quality characteristics are the primary parameter of concern with respect to the analysis of surface water resources for this investigation. However, the three water bodies that border on the study area do not have an equal potential for being adversely impacted by the activities of residents in the subject communities. Fire Island Inlet and the Atlantic Ocean are well-flushed due to the energetic action of tidal currents and because of the virtual lack of areas (e.g., as coves, leads, basins, etc.) that are protected from physical forces such as waves and currents. In contrast, Great South Bay contains numerous sheltered areas, in which contaminants tend to concentrate due to diminished flushing. Furthermore, human activities are typically most intense in the sheltered area behind the barrier island, which is true for the study area; four of the six communities (comprising 223 of the 415 houses) are located on the bay side of Ocean Parkway, while the remaining 192 houses in two communities are located on the Fire Island Inlet side of Ocean Parkway. None of the houses in the study area front directly on the Atlantic Ocean.

Because of the geographic distribution of the residences in the study area and the general hydrodynamics of the adjacent water bodies, as discussed above, the potential for surface water impacts caused by these homes and ancillary uses is greatest in the nearby reaches of the bay. Consequently, the discussion under this study element focuses on Great South Bay.

The following discussion opens with a review of the general physical characteristics of Great South Bay (Section 2.1). An examination of the impacts to surface water quality that typically result from residential communities (Section 2.2) is followed by a description of applicable standards, guidelines, and legislation (Section 2.3). Section 2.4 analyzes available water quality data for the portion of Great South Bay in the vicinity of the study area, while Section 2.5 contains a discussion of the impacts that have been identified through that analysis. Finally, mitigation alternatives are evaluated in Section 2.6.

2.1 GENERAL PHYSICAL CHARACTERISTICS OF GREAT SOUTH BAY

Great South Bay is approximately 25 miles (40 kilometers) in total length between South Oyster Bay to the west and Narrow Bay to the east. Width varies greatly: from about 0.2 mile (0.3 kilometers) at Smith Point at the bay's eastern end; to 7 miles (11 kilometers) south of Bayshore, just east of Fire Island Inlet. To the north of Jones Island, Great South Bay is approximately 10 miles (16 kilometers) in length and is generally 1 to 2 miles (2 to 3 kilometers) in width.

Great South Bay is a geologically young feature, formed within the past few thousand years by rising sea level. Further, the bay will not be a long-lived geologic feature. With its future controlled by sediment deposition and the evolution of the barrier islands, it is believed that only a few thousand years remain before Great South Bay ceases to be an open body of water (Schubel, et.al., 1991).

Depth within the entire Great South Bay averages only about 7 feet (2 meters) at mean low water. The reach of the bay north of Jones Island is generally only 3 to 4 feet (0.9 to 1.2 meters) in depth. However, depths within the State Boat Channel along the northern side of the barrier increase dramatically, to more than 20 feet (6 meters) in some spots, due to tidal currents and dredging. The flood tidal delta of Fire Island Inlet (i.e., the shoal of sand deposited from the flood tide at the inner reach of the inlet) is the most prominent bathymetric feature on the bay bottom.

Great South Bay is an estuarine body of water, characterized by the mixing of saline ocean water and freshwater input from the Long Island mainland via runoff and groundwater flow. Salinity within the bay is controlled by the dynamic balance between two primary factors: the rate of freshwater flow from the mainland, and the rate of tidal flow through its inlets. Fire Island Inlet serves as the main connection between Great South Bay and the ocean. Indirect connections exist to Moriches Inlet through Narrow Bay and Moriches Bay to the east, and to Jones Inlet through South Oyster Bay to the west. Mean salinity within the bay generally decreases outward from Fire Island Inlet, and increases again toward the indirect connections to Moriches and Jones Inlets at the eastern and western margins of the bay.

The astronomical tide (i.e., the daily tides caused primarily by the rotation of the earth on its axis and the revolution of the moon around the earth) is the agent that is most responsible for producing circulation within Great South Bay. Due to the bay's small volume to surface area ratio, local wind forcing and large-scale weather systems are also important, and sometimes dominant, in controlling the exchange of water between the ocean and the bay (Schubel, et.al., 1991).

The astronomical tide causes a high water level every 12.42 hours (called the semi-diurnal high tide). The tidal range (i.e., the difference in elevation between mean high water and mean low water) is approximately 4 feet (1.2 meters) at the westernmost tip of Democrat Point, and decreases into Great South Bay as a result of the damping effect of the constricted inlet. At Oak Beach, the tidal range is approximately 2 to 3 feet (0.6 to 0.9 meter). Within Great South Bay, the tidal range is less than one foot (0.3 meter). Since the passage of the tidal wave is delayed by frictional resistance against the narrow inlet opening and the shallow bottom of the bay, the time of high tide is progressively later with increasing distance from the inlet. Because of this factor, high tide occurs at the western end of the study area approximately three hours later than the time of high tide at Fire Island Inlet (Woods Hole Oceanographic Institute, 1951).

The maximum current velocity caused by the flow of the mean tide through Fire Island Inlet is approximately 2.6 mph (4.3 km/hr). Tidal flow through Great South Bay tends to favor the State Boat Channel, where maximum velocities are 0.9 mph (1.1 km/hr). Tidal current velocities are generally less than 0.7 mph (1.1 km/hr) within the central portion of the bay (Marine Sciences Research Center, 1973).

The flushing time of a water body is defined as the average time required for water molecule introduced into the bay via rainfall, runoff or seepage to pass out of the water body through its boundaries (which, in the case of Great South Bay, are Fire Island Inlet and the connections to South Oyster Bay and Moriches Bay). An analysis performed by the Woods Hole Oceanographic Institute (1951), which was based strictly on a consideration of the advective movement of water through Fire Island Inlet (i.e., the volume of water introduced into the bay through the above sources must equal the volume exiting through the boundaries), indicated that the flushing time for Great South Bay is approximately 96 tidal cycles (about 48 days). However, it is important to note that, based on data in the same report, it can be seen that approximately one-eighth of the volume of water in Great South Bay passes out through Fire Island Inlet during any given ebb tide. Although an approximately equal volume of water enters the bay during the following flood tide, this water has been mixed to a large degree with cleaner ocean water. If tidal mixing of the ebb flow is considered in addition to advection, the flushing time of Great South Bay would be somewhat less than 48 days. Additionally, flushing time is lower for locations within the bay than nearer to the inlet.

2.2 POTENTIAL WATER QUALITY IMPACTS FROM THE OUTER BEACH COMMUNITIES

The range of activities for which a given body of surface water can be used is highly dependent on the level of contamination that exists within the water column and the bottom sediments. In particular, the presence of certain contaminants above specified levels will preclude the utilization of a water body for some of the more sensitive uses (e.g., shellfish harvesting and swimming).

Surface water quality can be degraded by a variety of sources related to residential development. These sources can be classified into two general categories: point sources and non-point sources. A point source is any input that emanates from a discrete, easily identifiable location, such as a pipe outfall. A non-point source is a diffuse input over a large area, such as precipitation. The distinction between these two categories is not always obvious. Stormwater runoff, for example, may start as a non-point source derived from a large area. However, if runoff is collected and discharged to receiving waters via an outfall pipe, this can be considered a point source.

The principal sources of contaminants from coastal residential communities include stormwater runoff, groundwater flow (which contains septic effluent from subsurface sewage disposal systems), and waste discharges from boats. The non-point sources are the most significant causes of surface water contamination. Of these, stormwater flow is the more important source of bacterial pollution (LIRPB, 1978) due to the rapid movement of runoff to receiving waters and the relatively minor degree of filtering that this water receives prior to discharge. Groundwater flow moves much more slowly than runoff, allowing time for purification processes to operate, and is subjected to natural filtering as the water seeps through the soil.

Surface water quality can be measured in terms of a large number of parameters, including micro-organisms (e.g., coliform and fecal coliform bacteria), nutrients (e.g., nitrogen, phosphorus, etc.), organic compounds (e.g., polychlorinated biphenals, polyaromatic hydrocarbons, pesticides, herbicides, etc.), and inorganic constituents (e.g., metals). The level of bacterial contamination is generally the most important water quality factor in estuarine waters. Fecal coliforms originate in the intestinal tracts of warm-blooded animals, which also serve as a primary source of certain pathogenic bacteria and viruses (e.g., hepatitis virus). Although it is these pathogens that are of concern with regard to potential human health consequences, the current methods for the detection of these microbes are often time consuming and tedious. In contrast, the measurement of coliform levels is relatively straightforward. Consequently, presence of fecal coliforms and total coliforms in surface waters is a widely used indicator of the possible presence of pathogenic micro-organisms.

2.2.1 STORMWATER RUNOFF IMPACTS

Since rainwater is relatively free of contaminants, the deleterious substances that characterize stormwater runoff are accumulated from the land surface. As noted above, fecal coliform bacteria and associated microorganisms are the primary constituents of concern with respect to surface water pollution. These contaminants can be found in stormwater runoff derived from undeveloped land (due to the presence of native birds and wildlife) as well as from developed areas (due to the presence of domestic animals and native species). Thus, nearshore and wetland areas with high wildlife and avian concentrations would serve as significant source of fecal coliform contamination to adjacent surface waters. Likewise, large populations of domestic animals which are allowed to roam out-of-doors (e.g., the duck farms that were once common on eastern Long Island) would also contribute to the fecal coliform loading of nearby water bodies.

A number of parameters affect the portion of precipitation that reaches receiving waters as stormwater runoff. The main factors that determine runoff rate are topography, soil properties, vegetative cover, and extent of impermeable surfaces. In the study area, the topography is relatively level, which tends to produce a lower rate of runoff than in areas that are more steeply sloped. Furthermore the soils in the study area are typically very sandy, having high permeability, which results in rainwater seeping quickly into the ground. The presence of a vegetative cover also decreases the amount of runoff, due to uptake of soil water by the plants and the subsequent loss of water to the atmosphere through the process of transpiration. In areas of pavement, buildings, and other impervious surfaces, the infiltration rate is zero and there is no vegetation to absorb water. However, in the study area, areas of impermeable cover generally drain to adjacent vegetated areas with highly permeable soils, which limits the amount of runoff reaching surface waters.

The direct piping of stormwater drainage from roadways in the subject communities to adjacent surface waters was only observed to occur at the western end of the Gilgo Beach community, where there are two closely-spaced catch basins that are connected to a pipeline which discharges through the bulkhead. In addition, some of the stormwater drainage from the Oak Beach Association is discharged through a pipe that outlets into Fire Island Inlet at a location approximately 800 feet east of the West Gate groin. The drainage that flows through this pipe passes through a network of wetlands that are interspersed among the developed lots, which during typical rainfall provide pretreatment prior to discharge. However, the extent of contaminant removal is reduced during extreme rainfall events, since the increased rate of flow through the wetland diminishes the rate at which solids settle from the stormwater.

2.2.2 SEPTIC EFFLUENT IMPACTS

As with 80 percent of Suffolk County residents, sanitary waste disposal within the study area is achieved by means of individual subsurface sewage disposal systems (SSDSs). Treatment occurs primarily through the settling of solid materials in a septic tank, and the passage of the effluent from the septic tank through the underlying substrate. The most efficient filtration is provided by a sandy substrate, such as exists throughout the study area. When operating properly, these systems can provide adequate treatment to reduce the concentration of deleterious substances to acceptable levels.

Although groundwater resources are generally most vulnerable to impact from SSDS effluent (see Section 3), surface waters can also be adversely affected by malfunctioning systems. The potential for surface water impacts is greatest in areas of shallow groundwater that lie directly on the shoreline (i.e., all of the subject communities except West Gilgo Beach), especially in cases of older septic systems which commonly malfunction due to substandard maintenance. Under these conditions, poorly treated septic effluent can be quickly transferred to adjacent surface waters by means of groundwater flow or overland flow.

In cases where development has been sited immediately adjoining wetlands, which applies particularly to the low-lying areas of Gilgo Beach East and eastern and western Oak Island, the problem of failed septic systems is compounded. The average grade elevation in these two areas lies only a few feet above the water table. This condition allows wastewater to pass directly into the adjoining wetlands without any significant degree of treatment. Although sewage elements such as bacteria, nitrates and phosphates would tend to be removed as the effluent passes through a wetland during normal weather conditions, extremely high tides and storms can transport the untreated wastewater directly to adjacent portions of the bay.

2.2.3 BOATING IMPACTS

Sanitary waste discharges from boats can be a significant seasonal contributor to coliform levels in restricted waterways, such as the West Gilgo and Gilgo boat basins. As a precautionary measure, NYSDEC closes these areas (as well as all of the embayments along the north shore of the barrier island, including Hemlock Cove) to shellfish harvesting during the period of greatest boating activity, between May 14 and September 30 each year (deQuillfeldt, 1992). During the remaining 7-½ months of the year, when boating activity is minimal, as is the potential for significant coliform loadings from this source, shellfish harvesting is allowed in areas of bay bottom governed by seasonal closures.

The boats associated with the Outer Beach communities probably have a minimal impact on coliform levels in study area waterways, since these vessels are docked in close proximity to the sanitary facilities in the residences. In addition, the terms of the leases prohibit living aboard vessels. The primary concern with respect to potential sewage discharges from boats in the study area involves transient vessels, which can be occupied for extended periods of time but have limited (or no) access to shore-based sanitary facilities.

Boating activity can also result in the introduction of a number of other contaminants directly into surface waters. Oils, gasoline, detergents, and litter are examples of the types of wastes that are derived from water craft, in addition to sanitary discharges.

Propeller wash in shallow areas can result in the resuspension of bay bottom sediments, which adversely affects water quality. However, the magnitude of resuspension caused by this agent is minuscule compared to the continuous natural process of tidal flow and the episodic processes of wind mixing and storm wave action.

Dredging, which is performed to facilitate the passage of boats through shoaling sections of the near-shore zone, can also cause locally significant sediment resuspension. However the impact of dredging is temporary and, like propeller wash, the amount of sediment resuspended by dredging is not important on an overall scale compared to the powerful effect of natural forces on the shallow bay bottom.

2.3 APPLICABLE STANDARDS, GUIDELINES, AND REGULATIONS

2.3.1 WATER QUALITY STANDARDS

Standards for surface water quality have been promulgated primarily for two purposes: to ensure that shellfish harvested for human consumption are not contaminated to a degree that creates a health hazard, and to ensure that the waters of bathing beaches are safe for primary contact recreation. The New York State Department of Environmental Conservation (NYSDEC) regulates the use of surface waters for shellfish harvesting, while the Suffolk County Department of Health Services (SCDHS) is responsible for monitoring water quality at bathing beaches in Suffolk County.

New York State (2 NYCRR Part 701.20) has established a classification system which defines the best intended use of all surface waters under its jurisdiction. A classification of "SA" indicates that the best intended use is for shellfish harvesting for the purpose of human consumption, which requires the highest level of water quality. The regulations promulgated by NYSDEC for SA waters establishes criteria for the maximum median value for total coliform concentration of a series of representative samples, the minimum dissolved oxygen concentration, and a general requirement that the water be free of deleterious substances in concentrations that would cause adverse impacts. Importantly, an SA classification is not necessarily indicative of existing water quality conditions in all cases. Certain water bodies which have been classified SA by NYSDEC consistently fail to meet the standards. In these cases, the SA designation is used by the State to set discharge guidelines and land use standards which are aimed at improving water quality, with the ultimate goal being that conformance with the SA criteria will eventually be attained and the area of certified shellfish beds will be expanded. The entire area of Great South Bay in the vicinity of Jones Island, including tributary channels and basins, has been designated SA by NYSDEC.

In order for an area of bay bottom to be officially certified as being suitable for shellfish harvesting, the overlying waters must meet the following coliform criteria (dequillfeldt, 1992);

- the median total coliform level for any series of water samples must be 70 MPN/100 ml or less (where MPN/100 ml is the most probable number of organisms per 100 milliliters of sample); and
- no more than 10 percent of the samples collected can exceed a total coliform level of 330 MPN/100 ml; and

- the median fecal coliform level for any series of water samples must be 14 MPN/100 ml or less; and
- no more than 10 percent of the samples collected can exceed a fecal coliform level of 49 MPN/100 ml.

2.3.2 PERTINENT REGULATIONS

A. *Tidal Wetlands Land Use Regulations*

The Office of Tidal Wetlands in the NYSDEC Bureau of Marine Habitat Protection enforces the New York State Tidal Wetlands regulations. Part 661.6(2) of these regulations specifies a minimum setback of 100 feet between the landward edge of any tidal wetland and any septic tank or septic leaching pool. This restriction is intended to ensure that adequate filtration is provided to septic effluent before it reaches tidal wetlands.

Most of the houses in the study area were constructed prior to the original adoption of the Part 661 regulations. Therefore, the SSDSs connected to these house were not necessarily installed in accordance with present setback requirements. Although the location of SSDS components in the subject communities is not generally known except for recently constructed houses, it is likely that SSDSs in some portions of the study area are nearer than 100 feet to tidal wetlands. Substandard setbacks are most evident in Gilgo Beach East and eastern Oak Island, where significant portions of the leased lots extend beyond the tidal wetland boundary.

Part 661.6(3) of the New York State Tidal Wetlands regulations specifies that a minimum of two feet of soil shall be provided between the bottom of SSDS components and seasonal high groundwater. As with the setback requirement, this standard has been formulated in consideration of the filtration of septic effluent. Some of the existing SSDSs in certain portions of the study area, particularly in those areas which are identified above as failing to meet setback requirements, are also in apparent contravention of the depth to groundwater standard.

B. *Standards for Subsurface Sewage Disposal Systems*

The SCDHS has developed standards that regulate the construction of SSDSs in Suffolk County. These regulations are enforced by the Office of Wastewater Management in the SCDHS Division of Environmental Quality. Section 5-107 of the standards specifies a setback from surface waters of 75 feet for septic tanks and 100 feet for septic leaching pools. As with the NYSDEC standard for setbacks to tidal wetlands, this SCDHS surface water setback is intended to create an adequate zone of filtration between an SSDS and adjacent sensitive areas; and as with the wetland setback, it is apparent that the surface water setback has been contravened by existing SSDSs in a number of areas on the Outer Beach. In particular, the northerly row of houses at Gilgo Beach West are situated on lots that are only about 80 feet in depth from the bulkhead line to the internal roadway. Additionally, the houses on Captree and Oak Islands (except for houses in the wooded central portion of Oak Island) are situated on lots that are generally less than 200 feet in depth between the shoreline and the marsh. Consequently, the SSDSs at these locations are either in contravention of the tidal wetland setback or the surface water setback (each of which is 100 feet for leaching pools), and most likely are not in compliance with both standards in some cases.

C. *Town of Babylon Ordinances*

Chapter 86 of the Town Code regulates boating activity within Town waters. Sections 86-17 and 86-18 have applicability to the issue of surface water quality. Section 86-17 prohibits the dumping of oil, chemicals, cesspool waste, garbage and rubbish in Great South Bay and its tributary channels. Section 86-18 prohibits the discharge of marine toilets in basins, marinas, docks, and bathing areas. These regulations are enforced by the bay constables who work out of the Department of Enforcement and Security.

Section 106-10.1 of the Town Code prohibits dog owners (or attendants) from allowing their dogs to defecate on any public property, or on any private property without the permission of the owner. The road area between the curb lines can be used to curb a dog, provided that the person who curbs the dog collects, removes, and properly disposes of the wastes produced. Disposal of dog feces in street stormwater collection systems is prohibited. A primary intent of this legislation is to minimize the amount of fecal coliform material introduced into surface waters. These regulations are enforced by the Division of Animal Control in the Department of Environmental Control.

Stiff monetary penalties and prison terms have been set for violations of any of the Town-enforced laws discussed above.

2.4 AVAILABLE WATER QUALITY DATA

2.4.1 NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION DATA

NYSDEC has compiled a report (deQuillfeldt, 1992) which summarizes coliform data collected between September 1988 and May 1992 (see Appendix B). A total of nine stations (6, 6.1, 7, 7.1, 13, 14, 15, 16, and 17) are in close proximity to the residential communities in the study area, while ten stations (8, 8.1, 9, 9.1, 10, 10.1, 11, 11.1, 12, and 12.1) are located along the intercoastal waterway or in tributary coves that are not adjacent to the subject communities. Sampling was conducted during adverse pollution conditions (APC, which is defined as an outgoing tide within 96 hours of a precipitation event of 0.25 to 2.99 inches) and during extraordinary conditions (XS, which is defined as being within 96 hours of a 3.00-inch or greater rainfall or following extreme high tides associated with storm events). The APC data indicates the following:

- the median total coliform standard of 70 MPN/100 ml was not exceeded at any of the 19 stations;
- only one station (#10, located at the Cedar Beach marina, in an area not proximate to the subject communities) had more than 10 percent of its samples exceed a concentration of 330 MPN/100 ml for total coliforms;
- the median fecal coliform standard of 14 MPN/100 ml was exceeded at only one station (#10); and
- no station had more than 10 percent of its samples exceed a 49 MPN/100 ml concentration for fecal coliforms.

All stations sampled during XS conditions contravened NYSDEC requirements. Analysis of these data reveals the following:

- the seven stations that were sampled in the vicinity of the subject communities exceeded the 70 MPN/100 ml median total coliform standard by an average of 167 MPN/100 ml, compared to an average of 325 MPN/100 ml for the six stations not adjacent to these communities;
- an average of 28 percent of the samples from each station in the vicinity of the subject communities exceeded a fecal coliform concentration of 330 MPN/100 ml, compared to 33 percent for the samples collected at the stations not adjacent to these communities;
- the stations in the vicinity of the subject communities exceeded the 14 MPN/100 ml median fecal coliform standard by an average of 48 MPN/100 ml, compared to an average of 255 MPN/100 ml for the stations not adjacent to these communities; and
- an average of 47 percent of the samples from each station in the vicinity of the subject communities exceeded a fecal coliform concentration of 49 MPN/100 ml, compared to 62 percent for the samples collected at the stations not adjacent to these communities.

Even when the anomalous station (#10.1) at the mouth of Cedar Beach Marina is omitted from the analysis, the median concentration of both total and fecal coliforms was lower (on average) at the stations in the vicinity of the subject communities than at the stations not adjacent to these communities. See Section 2.5 for a discussion of CA's conclusions with respect to these data.

2.4.2 SUFFOLK COUNTY DEPARTMENT OF HEALTH SERVICES DATA

The SCDHS has routinely collected and analyzed water samples for the presence of coliform bacteria. Prior to 1987, SCDHS water quality investigations included stations in the vicinity of the study area, as well as stations in the central and northern portions of western Great South Bay. Subsequently, SCDHS sampling in western Great South Bay has been limited to only two stations off the mainland, which is in keeping with their objective to monitor the water quality of the bathing beaches located on the Long Island mainland (there are no bathing beaches on the north side of the barrier island).

As part of this study, chronological data provided by SCDHS were summarized by station location (see Appendix B). Three of the stations (230, 260, and 290) are located near the subject communities, either on the State Boat Channel or Fire Island Inlet. Two stations (250 and 280, located in the central portion of the bay, north of the study area), and one station (210, located to the northeast of Grass Island) were used as control sites.

The primary analysis that was performed on the SCDHS data, which has been summarized in Table B-1 in Appendix B, is similar to the NYSDEC analysis discussed above. Note that all six SCDHS stations conform with NYSDEC requirements for shellfish harvesting with respect both to total coliform and fecal coliform levels.

The SCDHS data were subjected to further analysis in order to determine the frequency with which samples from the three stations nearest the study area exceeded NYSDEC requirements, compared to samples collected at the three stations in the main portion of the bay. The findings of this analysis, which were derived from the data summary contained in Table B-2 in Appendix B, are discussed below.

- 12 percent of the samples from the three stations nearest the subject communities exceeded the 70 MPN/100 ml median total coliform standard, compared to 17 percent of the samples from the three stations not adjacent to these communities
- 4 percent of the samples from the three stations nearest the subject communities exceeded a total coliform level of 330 MPN/100 ml, compared to 6 percent of the samples from the three stations not adjacent to these communities
- 10 percent of the samples from the three stations nearest the subject communities exceeded the 14 MPN/100 ml median fecal coliform standard, compared to 18 percent of the samples from the three stations not adjacent to these communities
- 3 percent of the samples from the three stations nearest the subject communities exceeded a fecal coliform level of 49 MPN/100 ml, compared to 6 percent of the samples from the three stations not adjacent to these communities

See Section 2.5 for a discussion of CA's conclusions with respect to these data.

2.4.3 ANTICIPATED FUTURE SURFACE WATER QUALITY TRENDS

The SCDHS data do not show any obvious trend in coliform levels during the 1977 to 1987 period of analysis; values that exceed NYSDEC standards for certified waters were no more common in the 1980s than in the 1970s. Further, NYSDEC's analysis, which covers a sampling period of September 1988 to May 1992, does not identify any adverse water quality trends in the vicinity of the study area.

The findings of the analyses discussed above indicate that overall water quality in the southern portion of western Great South Bay (and tributary embayments) has not undergone significant recent change. Since it is not anticipated that activities within the study area and vicinity will vary substantially from present conditions during the course of the current lease term (i.e., the subject communities will not exceed their present level of development, and the surrounding area will continue to be utilized for a mix of public recreation and natural open space), no significant deterioration in the water quality of southerly portion of western Great South Bay in the vicinity of the study area is expected during the foreseeable future.

2.5 ASSESSMENT OF CURRENT SURFACE WATER QUALITY IMPACTS

The data compiled by both NYSDEC and the SCDHS (see Section 2.4) indicate that the waters of Great South Bay in the vicinity of the study area do not contain levels of coliform bacteria that are elevated compared to other locations in the bay. In fact, analysis of these data reveals that coliform contamination of surface waters near the subject residential communities appears to have been slightly lower than in the main portion of the bay. This finding is supportive of the conclusion that the Outer Beach communities do not appear to have had an significant overall impact on local surface water quality, at least with respect to the important criterion of bacterial concentrations. Thus, the surface water quality control measures that are already in place in the study area have been generally adequate.

One of the main reasons for the apparent absence of a significant surface water impact from the subject communities is that only a small portion of the stormwater runoff generated in these communities is discharged directly to the bay. Most of the residential portion of the study area is comprised of vegetated land, which efficiently absorbs rainwater before it collects as overland runoff. Runoff that is generated within the developed portions of the study area generally flows to adjacent areas of native vegetation, which allows for additional infiltration into the ground and serves to filter overland runoff prior to ultimate discharge to surrounding surface waters. The abundant wetlands in the vicinity of the subject communities also serve an important role in preserving water quality, since suspended impurities are filtered from the water that passes through tidal marshes.

Notwithstanding the positive composite assessment of the subject communities given above, certain specific problems have been identified which have had (or are believed to have had) an adverse impact on surface water quality. The primary concern centers on the state of sewage disposal devices in the study area. The ability of SSDSs to provide adequate wastewater treatment is generally acknowledged to diminish with increasing age, especially if maintenance requirements are neglected. As noted in Section 2.2.2, this problem is particularly acute in areas of high water table and low elevation, such as Gilgo Beach East and the eastern shore of Oak Island. Existing regulations do not contain any provisions that work to mitigate the condition of existing SSDSs. However, the impact of deteriorating septic systems has been at least partially offset by the construction of new homes and substantial improvement to existing homes, which are required to be equipped with new SSDSs that conform with strict standards established by the SCDHS.

Improper sewage disposal from watercraft can have a significant impact on coliform levels in marina and boat mooring areas. The most concentrated boating activity by the residents of the Outer Beach communities is centered at West Gilgo and Gilgo boat basins, where there is also a substantial population of boats in private marina facilities in addition to significant use by transient vessels. However, it does not appear that coliform contamination is any more severe in these two basins than in the other embayments along the north shore of the Babylon barrier island. In fact, based on data collected during NYSDEC's September 1988 through May 1992 period of analysis, only Cedar Beach Marina, which is not adjacent to any of the subject communities, failed to meet NYSDEC standards during rainfall events of 0.25 to 2.99 inches. Coliform levels in West Gilgo and Gilgo boat basins conformed with NYSDEC shellfish harvesting standards except during extraordinary weather conditions (i.e., 3.00 inches or more of rain or extremely high storm tides). These data indicate that stormwater runoff, rather than vessel discharges, is the most significant controlling factor in the water quality of West Gilgo and Gilgo boat basins. It is more likely that vessel discharges is a significant factor in the water quality problems at Cedar Beach Marina, since this area suffers from high coliform levels even during less intense weather conditions.

As was noted in Section 2.2.3, the potential for water quality problems caused by boat sewage discharges is mostly associated with transient vessels, which may be occupied during extended periods of time but have limited (or no) access to shore-based sanitary facilities. Boats that owned by Outer Beach residents are not occupied at dockage for long time periods (in fact, the leases prohibit such activity) and accessible sanitary facilities are nearby at the residents' homes.

2.6 RECOMMENDED MITIGATION MEASURES

As discussed above, it does not appear that the barrier and bay island communities have had a significant impact on local water quality. This result has been achieved primarily through a community design that has minimized the amount of stormwater runoff that is discharged directly into the bay. The residential portion of study area is comprised mainly of vegetated land, which efficiently absorbs rainfall. Runoff from the small areas of impervious surfaces in the subject residential communities generally flows to adjacent vegetated land, where this water percolates into the ground and is filtered through the substrate prior to eventual discharge to adjacent surface waters. In contrast, a large portion of the stormwater runoff generated on the south shore of mainland Long Island is discharged to surface waters with little or no treatment, and this situation is largely responsible for the deteriorated water quality that exists in northern Great South Bay (LIRPB, 1978).

Implementation of the following general recommendations will help to ensure that the study area continues to be a relatively minor contributor to the coliform loadings of local water bodies.

- All activities within the subject communities should be undertaken so as to maintain the existing vegetative buffers, including both upland vegetation and tidal wetlands.

- No construction activity should be permitted which involves the direct discharge of stormwater to surface waters or tidal wetlands.

- All new paved areas within the subject communities that are 300 feet or less from a surface water body or tidal wetland should consist of permeable surfaces (e.g., gravel for vehicles and wooden boardwalks or gravel for pedestrians).

- Where permeable surfaces are constructed in the subject communities, these surfaces should be designed to ensure that runoff will not reach adjacent surface waters or tidal wetlands. If the area between a proposed paved surface and a water body or wetland will not provide an adequate buffer, leaching pools should be required.

- Appropriate sediment and erosion control measures (e.g., hay bales, silt fencing, temporary seeding, etc.) should be implemented for all activities within the subject communities that will result exposed soils that can potentially be carried to nearby surface waters or wetlands.

- Boaters in the subject communities should be made aware of the locations of wastewater pumpout stations in the vicinity of the study area, including dockside signs, as appropriate.

- Signs should be installed at suitable locations to direct transient boaters to the nearest pumpout stations.

2.7 REFERENCES

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SECTION 3

SECTION 3
GROUNDWATER

SECTION 3

GROUNDWATER

3.0 INTRODUCTION

CA has compiled information and data concerning groundwater hydrology, quality and usage in the study area. This has served as a baseline for evaluation of the effects of the subject barrier and bay island communities on the groundwater system. Based on these findings, CA has identified feasible measures available to the Town, other governmental agencies, and the homeowners to mitigate the impacts of long-term groundwater degradation.

This section of the report is divided into six subsections. Section 3.1 provides a description of the hydrogeology of the barrier and bay island communities. Sections 3.2 and 3.3 describe the water supply and sanitary disposal systems in the communities. In Section 3.4, a description of the water quality data compiled and evaluated for this study is provided. An assessment of the quality of the groundwater in the study area is provided in Section 3.5 and proposed mitigation measures are provided in 3.6.

3.1 GENERAL HYDROGEOLOGY OF THE STUDY AREA

3.1.1 AQUIFER SYSTEM

The study area is located in an area underlain by several hydrogeologic units known, from top to bottom, as the Glacial formation, the Gardiners Clay, the Magothy aquifer, the Raritan clay and the Lloyd aquifer. These units rest on a bedrock surface that lies about 1,700 to 1,900 feet below sea level at the site (Perlmutter and Crandell, 1959, and U.S.G.S. Water Supply Paper, 1964). A cross-sectional view of the hydrogeology of the study area and surrounding vicinity is provided in Figure 3-1.

The Lloyd and Magothy aquifers contain fresh water. In the study area, public drinking water supply wells generally pump from the Magothy aquifer at a depth of 250 to 350 below sea level. The Glacial formation, consisting chiefly of beds of coarse sand and gravel, has a total thickness of about 100 feet. Salt water, having a chloride content of approximately 17,000 ppm (the chlorinity of seawater) is present in much of the Glacial formation beneath the study area. Lenses of fresh water as much as 40 feet thick, however, are present in the Glacial formation where the water table rises two to three feet above sea level near the center of the barrier island (Perlmutter and Crandell, 1959). This shallow fresh water lens, which is a result of direct precipitation, is being pumped for water supply by some homeowners in Gilgo Beach, Oak Beach and Captree (See Section 3.2). This water is generally used for non-potable uses such as lawn irrigation, toilets and showers.

Suffolk County is delineated by eight Hydrogeologic Zones, as defined in the Long Island Regional Planning Board's 1978 Areawide Waste Treatment Management Study, and amended by the NYSDEC's 1984 Long Island Groundwater Management Plan. The boundaries of these zones is based on the regional flow of groundwater and the relationship between land use and water quality. The study area is located in Hydrogeologic Zone VII, a zone of primarily horizontal flow, with upward flow and discharge at the shoreline.

3.1.2 GROUNDWATER MOVEMENT

Groundwater beneath the barrier beach occurs under both unconfined or water table conditions, and confined or artesian conditions. Unconfined water (water table) occurs in the Glacial formation. The water table is relatively flat, the maximum altitude being about 2 to 3 feet above sea level near the center of the barrier beach. The shallow fresh water lens in the Upper Glacial Formation moves in both directions from the "water-table divide" near the center of the barrier island-to the north toward the bay, and to the south toward the ocean (Perlmutter and Crandell, 1959).

Artesian water occurs in the Magothy and Lloyd aquifers (Artesian water is defined as an aquifer bounded above and below by confining formations or of formations of lower permeability, and under pressure greater than atmospheric pressure). The artesian water is derived generally by underflow from the artesian units inland, which are recharged by downward percolation of water from the Glacial formation near the middle of Long Island. Extensive clay layers, such as the Gardiners Clay, and Raritan Clay, undoubtedly cause some refraction of the flow lines, but do not significantly affect the overall pattern of movement (Perlmutter and Crandell, 1959).

3.2 WATER SUPPLY

In the study area there are both public and private water supply systems. Public supply systems are regulated by Part 5 of the New York State Sanitary Code, and are defined as community or noncommunity systems that have at least five service connections or serve at least 25 individuals at least 60 days out of the year. (A community system is a system that is used year round, a non-community system is used seasonally). Private water systems are regulated by Article 4 of the Suffolk County Sanitary Code, and are defined as systems that serve less than five units or serve less than 25 individuals daily. Private and public water supply systems servicing the study area are described in Sections 3.2.1 and 3.2.2.

Both private and public well systems must be tested; private wells upon installation and public wells on a routine basis. Both well systems must be tested for the State's list of organic, inorganic and microbiological water quality parameters.

3.2.1 PUBLIC WATER SUPPLIES

The community of West Gilgo Beach is serviced by a single community public water supply system known as the West Gilgo Beach Association system. This system consists of two Magothy wells, set at depths of 304 feet and 313 feet. These wells service 80 residential units, and provide an average daily yield of 14,000 gpd.

In Oak Beach, there are three non-community public water supply systems, as well as a number of private water supply wells. The three public supply systems are referred to as the McCrodden, McCarren and Dougherty systems (Paul Ponturo, SCDHS, December 9, 1992). The McCrodden system consists of one 310-foot Magothy well which services 18 residential units. The McCarren system services 15 residential units via a 305-foot Magothy well, and the Dougherty consists of a 300-foot Magothy well that services 14 residential units. These systems are at least 40 years old, and are reportedly used by seasonal residents (Paul Pontaro, SCDHS, December 9, 1992).

In addition to the Oak Beach systems, there are four other non-community public water supply systems located in the study area. These include the Town water supply wells at Gilgo Beach, Cedar Beach and Overlook Beach. At Cedar Beach, there are two separate water supply systems. One is a 327 foot well at the marina facility, and the second is a well of undocumented depth which services the maintenance building. All four of these wells tap into the Magothy Aquifer and are in operation only during the summer months.

The remaining portions of the study area are serviced by private water supply systems. These systems are discussed in Section 3.2.2.

3.2.2 PRIVATE WATER SUPPLY SYSTEMS

In the communities of Gilgo Beach, Captree Island, and Oak Beach Association, water supply is provided by private wells; there are no public supply systems. In the unassociated portion of Oak Beach, as discussed in Section 3.2.1, there are a number of private wells, in addition to the public supply systems described above. In all four of these communities, the private wells range in depth from shallow Upper Glacial wells to Magothy wells set at a depth of 250+ feet. The shallow wells are generally set at less than 40 feet, to draw from the fresh water lens near the water table surface. Most of the shallow wells are not used as a source of drinking water, but rather for other water uses such as showers and toilets. Refer to Appendix A for information concerning the use of private wells in the study area, as obtained through the homeowner's survey that was conducted as part of this investigation.

The community of Oak Island has neither public nor private water wells. Water is provided by both bottled water and rainwater cisterns.

Of the 415 homes in the study area, approximately 361 draw from underlying aquifers for water supply (as discussed, the 54 homes in Oak Island use bottled water and rainwater cisterns). Of these 361 homes, 168 are seasonal residences and the remaining 193 are year-round residences. Based on published unit pumpage rates of 105 gallons per capita per day (gpcd) for year-round residences and 12.5 gpcd for seasonal residences (Suffolk County Comprehensive Water Resource Management Plan, January 1987) and a residential occupancy rate of 2.4 persons per home (R. Fedelem, Demographer, Long Island Regional Planning Board, Hauppauge, NY, December 17, 1992), the total estimated volume of water pumped for residential use in the study area is 53,700 gallons per day.

3.3 SANITARY DISPOSAL

In the study area, sewage is disposed of in individual residential subsurface septic systems. These systems are regulated by standards set forth in Article 5, Section 502 and Article 7, Section 710 of the Suffolk County Sanitary Code. The purpose of these standards is to assure a safe, sanitary means of disposing of household wastewater, and to minimize the potential for contamination of groundwater and surface waters.

The above-noted standards set minimum setback distances which shall be maintained between subsurface sewage disposal systems and other items. In summary, septic tanks must be set 5 feet from a house (without a cellar), 5 feet from property lines, 10 feet from public wells, 75 feet from private wells, and 75 feet from surface waters. Leaching pools must be set 10 feet from a house (without a cellar), 200 feet from a public well, 100 feet from a private well, and 100 feet from surface waters. In addition, distance between leaching pools and wetlands are regulated by NYSDEC and are subject to State approval prior to issuance of Suffolk County approval. The NYSDEC separation distance requirement between leaching pools and wetlands is 100 feet.

Many of the septic systems in the study area do not conform to County code. Most were constructed prior to enactment of these regulations, and do not meet the separation distance requirements summarized above. For example, a number of septic systems on Oak Island, are located less than 75 feet from the bay, which does not meet the surface water separation requirement. Likewise, many septic systems on Oak Island, Captree and the east side of Gilgo Beach, are located less than 50 feet from nearby wetlands, which does not meet the NYSDEC wetland separation requirement of 100 feet.

3.4 EXISTING GROUNDWATER DATA

3.4.1 WATER QUALITY STANDARDS

The New York Public Health Law (Section 225) provides for the regulation of drinking water supplies (10 NYCRR part 5). The New York State Department of Health (NYSDOH) is the lead agency for drinking water regulation. The NYSDOH has established maximum contaminant levels (MCL's) or standards for approximately 118 potential drinking water pollutants. These include inorganic chemicals, pesticides, volatile organic compounds, microbiological and radiological parameters, and physical properties. The microbiological parameters include total Coliform and E. Coli. The radiological parameters include radium 226, radium 228, gross alpha, gross beta, tritium and strontium. The physical properties are color, odor, corrosivity and turbidity.

The MCL standards have been set by NYSDOH to ensure the aesthetic quality and safety (ie., no adverse health effects) of the drinking water supplies. These MCL's are legally enforceable limits. Public water supplies exceeding these limits are required by the regulatory authorities to take corrective action. These MCL standards will be referred to in subsequent sections of this document, and provide quality criteria for assessment of groundwater conditions in the study area.

3.4.2 AVAILABLE WATER QUALITY DATA

Groundwater quality data for the study area was available from several sources. These sources included the U.S. Geological Survey (USGS), SCDHS and a recent study undertaken be EEA, Inc., for the Babylon Barrier Beach Ad Hoc Committee.

The USGS has several observation wells located on the Barrier Island, including eight wells located in the study area and vicinity. These consist of a cluster of four wells located at Cedar Beach, a cluster of two wells in Gilgo Beach, and two separate wells located in the vicinity of Gilgo State Park. The location of these wells are shown on Figure 3-2. These wells have been monitored by the USGS for the presence of chlorides and other related constituents and are utilized by the USGS to study the aquifer system beneath the barrier island. Data from these wells was made available to CA for use in this study.

SCDHS has no observation wells on the Barrier Island. However, SCDHS did provide CA with groundwater quality data for some private homeowner wells, and public community and non-community wells in the study area. This included private well data from water quality surveys undertaken by SCDHS in 1981 at Oak Beach, and in 1984, at both Oak Beach and Gilgo Beach. In addition, CA examined data from SCDHS's routine sampling of public water supply systems at West Gilgo Beach, Cedar Beach, Cedar Beach Marina, Overlook Beach and Gilgo Beach. In most cases, the samples were obtained from the tap, and analyzed for SCDHS's standard list of organic and inorganic chemical parameters.

In the fall of 1990, EEA, Inc., an environmental consulting firm, conducted an environmental assessment study of the Babylon Outer Beach communities for the Babylon Barrier Beach Ad Hoc Committee. Part of that study involved the sampling of eighteen shallow wells located in developed and undeveloped areas of the study area and vicinity. The locations of these wells are shown on Figure 3-2. Samples from the developed areas were taken from shallow private homeowner wells. In the undeveloped areas, shallow wells were installed in the field, by EEA, Inc., sampled, and then removed. All of the wells were screened in the Upper Glacial Aquifer, and varied in depth from 3 to 20 feet below grade. Samples collected from the eighteen wells were analyzed for SCDHS's list of inorganic parameters. Results of the analysis were provided in the study report prepared by EEA, Inc. These data were reviewed by CA, and evaluated together with the USGS and SCDH data. These data served as a baseline for assessment of groundwater quality conditions in the study area.

3.5 GROUNDWATER QUALITY ASSESSMENT

CA evaluated the groundwater quality data available for the study area. This included data for shallow wells and Magothy wells provided by the USGS, SCDHS and a recent study undertaken by EEA, Inc., as discussed in Section 3.4.2. This analysis provided information on the quality of the groundwater and on the location of the saltwater-freshwater interface in the study area. These findings are provided below. A copy of the data evaluated in this study is provided in Appendix C.

3.5.1 GROUNDWATER QUALITY

The data indicate that the overall quality of the groundwater in the study area is good. Only three parameters were found in some wells to exceed the New York State Department of Health Maximum Containment Levels for drinking water. These included iron, total coliform and chlorides. No volatile organic compounds or pesticides were found above detection limits. Elevated levels of iron were present in both shallow and in deep wells, at concentrations ranging from <0.1 to 130 mg/l. (The State maximum containment level for iron is 0.3 mg/l). Coliform bacteria were present in a few shallow homeowner wells and in the wells installed in the undeveloped areas by EEA, Inc. Coliform bacteria were not detected in any of the Magothy wells. The State maximum contaminate level for coliform bacteria is "0", it should be absent.

Information on the saltwater-freshwater interface underlying the study area was obtained from published reports, and evaluation of USGS and SCDHS chloride data. The "interface" is usually defined by chloride concentrations greater than 40 or greater than 250 ppm and up to 17,000 ppm (Suffolk County Comprehensive Water Resources Management Plan, January 1987). The position of the interface fluctuates with changes in water table elevation and tidal oscillations near the shoreline.

The USGS has a well cluster located in Cedar Beach. This cluster consists of four wells, screened at depths of 48 feet, 73 feet, 88 feet and 117 feet below grade. The 117-foot well is screened in the Magothy aquifer, the others in the Upper Glacial Formation. Chloride concentrations in water samples collected from these wells during 1988-1989 sampling are as follows:

WELL DEPTH (FEET BELOW GRADE)	CHLORIDE CONCENTRATION (MG/L)
48	17,000
73	18,000
88	19,000
117	260

These data indicate that the saltwater-freshwater interface occurs at less than 117 feet below grade beneath the study area. This is further corroborated by data from another USGS well cluster located in Gilgo Beach, which consists of two wells; one screened at 70 feet in the Upper Glacial formation and the other at 184 feet in the Magothy formation. The shallow well, when sampled in 1989, had a chloride concentration of 17,000 mg/l. The deeper well, when sampled in 1986, had a chloride concentration of 260 mg/l. Again, this suggests that the salt-water interface occurs between 70 and 184 feet below grade. These data are consistent with chloride data for private and public supply wells in the study area that are screened at depths of 250 to 350 feet below grade. Water samples collected from these private wells had chloride concentrations in the range of approximately 3 to 20 mg/l.

The presence of a freshwater lens near the water table interface is confirmed by the SCDHS chloride data for shallow homeowner wells, and the data for the shallow wells installed by EEA, Inc. In Oak Beach, homeowner wells screened at less than 20 feet below grade generally had chloride concentrations less than 100 mg/l.

In Gilgo Beach, shallow homeowner wells had chloride concentrations less than 200 mg/l. Homeowners located close to the water, however, in both communities had elevated chloride concentrations in their wells (i.e., approximately 800 to 4,000 mg/l). These data corroborate the findings of the published studies of Perlmutter and Crandell (1959), discussed in Section 3.1.1. According to their study, lenses of freshwater, as much as 40 feet thick, are present in the Glacial Formation near the center of the Barrier Island.

3.5.2 IDENTIFICATION OF POLLUTION SOURCES

As indicated in Section 3.5.1, elevated levels of iron are present in many of the shallow Upper Glacial homeowner wells and in the deep Magothy public supply wells, in the study area. Such elevated iron levels are not uncommon in Suffolk County groundwaters. Iron generally occurs in high concentrations as a result of the dissolution of native minerals under low oxygen conditions. Low oxygen conditions are generally present in Upper Glacial waters below old bog deposits, which are high in organic content, and below clay lenses, where long residence times result in reduced oxygen levels. As discussed in Section 3.1, a formation known as the Gardiners clay underlies portions of the Glacial formation in the study area. High iron concentrations are also present in Magothy waters, where long residence times are responsible for low oxygen content.

Elevated levels of iron in well water can also be attributed to the corrosive properties of water. Well pipe, such as unlined cast iron, when corroded, can leach dissolved iron into the groundwater. Many of the older water supply systems in Suffolk County are comprised of unlined cast iron pipe.

The New York State Sanitary Code requires treatment whenever iron is found in well water at concentrations greater than 0.3 ppm, or when iron and manganese are found in a total concentration greater than 0.5 ppm. Several of the public and private wells in the study area do not meet these standards and, consequently, must undergo iron treatment. These include the West Gilgo Beach Association wells, and several homeowner wells. The treatment process commonly used is iron sequestion, which involves chemical complexing through the addition of sodium hexametaphosphate. The newly complexed compounds are stable, and will not deposit on fixtures or laundry.

The presence of coliform bacteria in shallow homeowner wells can generally be attributed to sewage from septic systems. As discussed in Section 3.3, many of the septic systems in the study area do not meet the required water well separation distances delineated in the regulations. In the EEA, Inc. study, shallow wells were installed in undeveloped areas of the barrier island

and when sampled, had elevated levels of total coliform. These elevated coliform levels are not attributable to septic systems, because none are present in these undeveloped areas. Since many of the locations where these wells were installed were likely near bird habitat, the presence of coliform bacteria, as well as elevated levels of ammonia and nitrate-nitrogen, may be a result of native animal wastes.

Furthermore, iron, coliform bacteria and other types of contamination can occur in the groundwater as a result of incorrect well abandonment procedures. Improperly sealing an out-of-service well can result in the introduction of surface contaminants into the underlying aquifer, and cross contamination of aquifers. This problem is of particular concern with respect to the possible transfer of chlorides to the deep drinking water aquifers from the intermediate salty groundwater zone. The SCDHS has indicated that a number of abandoned wells in the study area have created a "pin cushion" that penetrates through to the Magothy Aquifer. The corrosive properties of the salty water deteriorates abandoned well casings. Since saltwater is heavier than freshwater, chloride-laden water which enters abandoned wells sinks to the Magothy (Ponturo, SCDHS, October 15, 1992). Unsealed abandoned wells can also serve as conduits for the improper disposal of waste oils or other hazardous materials.

Importantly, contaminants that are introduced into the Upper Glacial Aquifer in the study area are not transferred to the important drinking water resources of the Magothy Aquifer. Unlike on mainland Long Island, where the Upper Glacial and Magothy are hydraulically connected, on the barrier island these two aquifers are separated by an intermediate saltwater zone. As noted in Section 3.1.2, the upper freshwater lens in the study area is fed directly by precipitation and flows laterally to the bay and ocean. The Magothy Aquifer beneath the study area is derived from southward flowing water that originates as precipitation onto the mainland.

As noted above, the EEA, Inc. (1991) study included a comparative assessment of groundwater quality in undeveloped and developed areas of the Outer Beach. The parameters tested included iron, manganese, ammonia, zinc, nitrate, chloride, hardness, alkalinity, total dissolved solids, copper, sulfate and total coliforms (see Appendix C). Certain constituents were found to be in higher concentrations in groundwater samples drawn from the developed areas. In particular, nitrate and ammonia levels were higher in the vicinity of the communities, though still well within Suffolk County drinking water standards, possibly indicating a minor effect from subsurface sewage disposal. However, the concentration of other important water quality criteria (e.g., zinc, copper, and sulfates) were lower in samples taken from the developed areas, indicating that the subject communities were not causing adverse impacts to groundwater quality in terms of these variables.

3.5.3 FUTURE GROUNDWATER QUALITY TRENDS

Elevated levels of iron in Glacial and Magothy wells, and the occurrence of coliform bacteria in shallow wells, will continue on an upward trend, unless well protection measures are undertaken. As the wells become older, and if corrosion or iron control methods are not employed, elevated iron levels will remain a problem in the water supply, and probably will increase in severity. Well corrosion will also cause other problems such as the loss of the hydraulic efficiency of the well, an increase in the production of aesthetically unpleasant rusty water, and increased chloride concentration.

Likewise, coliform-impacted shallow wells, unless treated by chlorination, will likely remain bacteriologically contaminated. In addition, as more seasonal residents become year round residents, as discussed in Section 6.6, the annual septic load in the study area, will increase. This could increase the number of shallow wells impacted by coliform bacteria.

The presence of elevated chloride levels in some of the wells in the study area will continue, because these wells are screened in the transition zone between fresh and salty waters. (On a much smaller scale, the presence of chlorides in the groundwater can be attributed to rainwater due to sea spray, and from road runoff as a result of parkway deicing). Chloride levels in the freshwater/saltwater interface are also affected by saltwater upcoming and intrusion. Upcoming or upward movement of the interface, will occur below a well, due to pumping. Saltwater intrusion is a landward movement of the interface in reaction to large net withdrawals. Both of these can be controlled by the strategic placement of wells, and conformance with County well design guidelines.

3.6 GROUNDWATER QUALITY PROTECTION MEASURES

3.6.1 EXISTING PROTECTION MEASURES

Groundwater protection in the study area is governed by a variety of federal, state, county and local regulations. The Suffolk County Sanitary Code are the main authority with respect to groundwater and water supply protection regulations. The three most relevant articles of the Code are Article 4, Article 6, and Article 12. Article 4 covers the protection of water supplies from potential sources of contamination, and sets design requirements for public and private water systems. Article 6 regulates sewage facilities and sets design standards for waste disposal units. Article 12 specifies requirements for the storage and handling of toxic and hazardous materials.

Most of the water supply systems (private and public) and septic systems in the study area were installed prior to promulgation or enactment of Article 4, Article 6 or Article 12 regulations. Therefore many of the systems have not been designed to Code and do not fully protect water supply systems from contamination or prevent degradation of the surrounding groundwater.

There are no specific Town regulations pertaining to groundwater protection measures, with the exception of Town of Babylon Code, Article I, Chapter 106 (Section 106-10.1). This regulation prohibits persons from allowing their dogs to defecate on common thoroughfares, sidewalks, play areas, parks or any Town property. The restriction does not apply to that portion of street lying between curblines. In these areas, the person who curbs a dog is required to immediately remove all feces deposited by the dog and dispose of it in a sanitary manner. As discussed in Section 3.5.2, animal wastes are a source of ammonia, coliform and nitrate-nitrogen contamination. Restrictions of dog feces on the ground serves to reduce the ammonia, coliform and nitrate-nitrogen loading to the groundwater.

3.6.2 RECOMMENDED MITIGATION MEASURES

This section presents measures that will protect the supply of potable water for all residents in the study area, including homeowners with private wells. These recommendations were developed based on the groundwater quality problems identified in Section 3.5.

A. Water Supply Recommendations

CA recommends that, where feasible, private homeowner wells used for potable water supply, be replaced with year-round community supply systems that service more than 5 units. These systems should be installed in the Magothy aquifer at depths sufficiently below the freshwater-saltwater interface to avoid saltwater contamination. These wells should be required to undergo disinfection, pH control, and iron removal or sequestion treatment, if necessary, and the operation of these systems should be performed by year-round treatment plant operators. At present, more than 84 percent of the Town's water supply is drawn from the Magothy. The remainder comes from the Glacial formation. These statistics are based on 1980 aquifer pumpage data, and Town pumpage projections (Suffolk County Comprehensive Water Resources Management Plan, Volume I, January 1987). The population of the study area represents approximately 0.2 percent of the total population of the Town of Babylon. If all the residents in the study area pumped from the Magothy Aquifer, there should not be any significant impact on this resource, in terms of quantity withdrawn or water quality.

Community supply systems, unlike private systems, are required by Part 5 of the State Sanitary Code to be monitored on a routine basis for water quality. This required testing prevents poor quality water from being used to serve drinking water needs, and ensures safe, clean water to all residents. CA recommends that private well systems also be required to be tested on a routine basis. This would provide private well owners with drinking water quality protection similar to that of the public supply systems.

B. Groundwater Contamination Protection Measures

As discussed in Section 3.5, the improper abandonment of wells can cause contamination of the groundwater system. Out-of-service wells can serve as conduits for the disposal of hazardous materials or can result in the introduction of surface contaminants into the underlying aquifers.

To prevent these occurrences, CA recommends that abandoned wells be properly sealed or entirely removed from the ground. These measures should serve to prevent unnecessary contamination of the underlying aquifers from out-of-service wells.

In addition, a study should be undertaken to assess the feasibility and advisability of installing centralized sewage treatment plants to replace the existing individual, on-lot systems. The recommended study should provide a comparison of the potential environmental benefits of this action versus the anticipated capital costs. The term of the current lease should also be taken into consideration.

The EEA, Inc. data indicate that the septic systems in the subject communities are having a measurable effect on the shallow aquifer, in terms of elevated levels of ammonia and nitrates. Since a disproportionate loading of these groundwater contaminants is released by older septic systems which provide inadequate treatment, homeowners should be encouraged to undertake proper maintenance of their septic systems and to upgrade or replace improperly functioning systems.

3.7 REFERENCES

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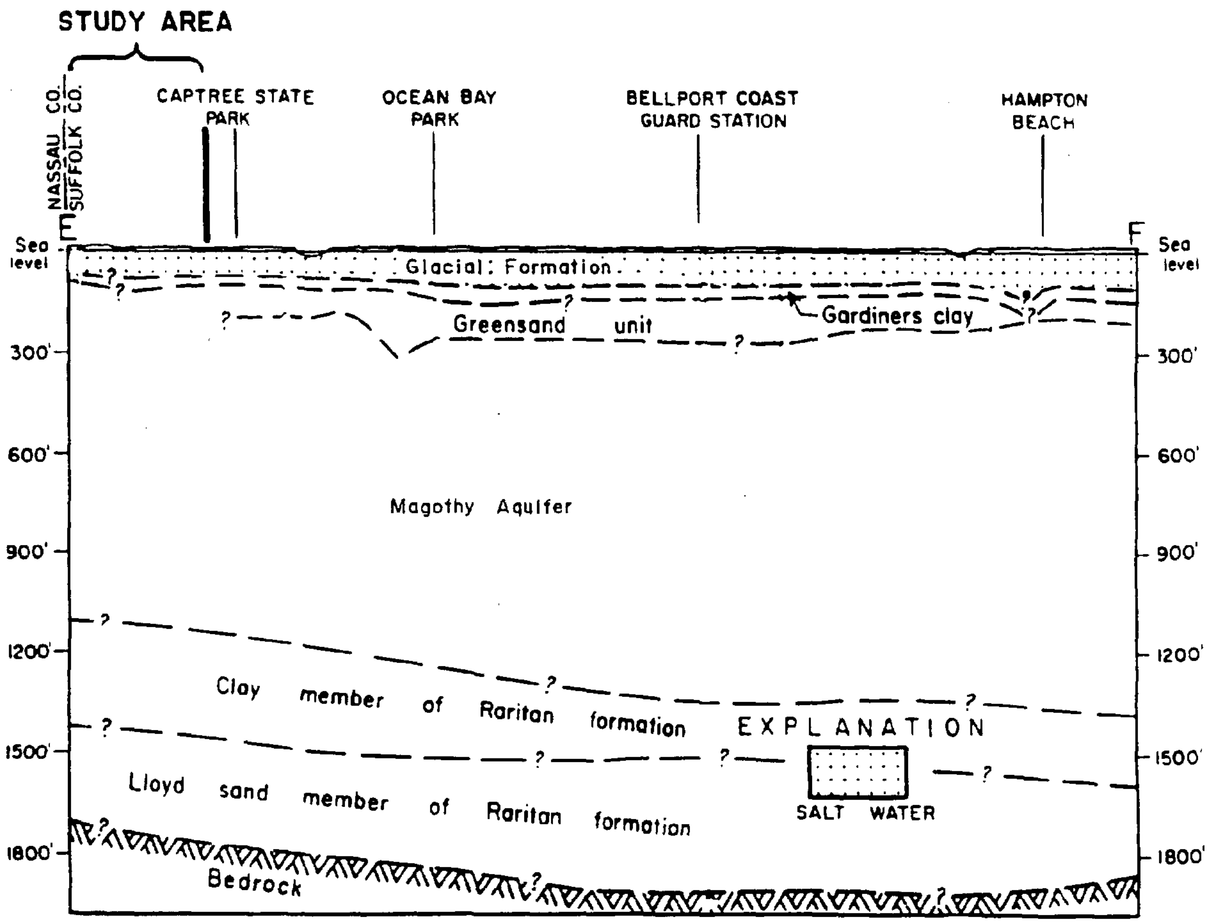
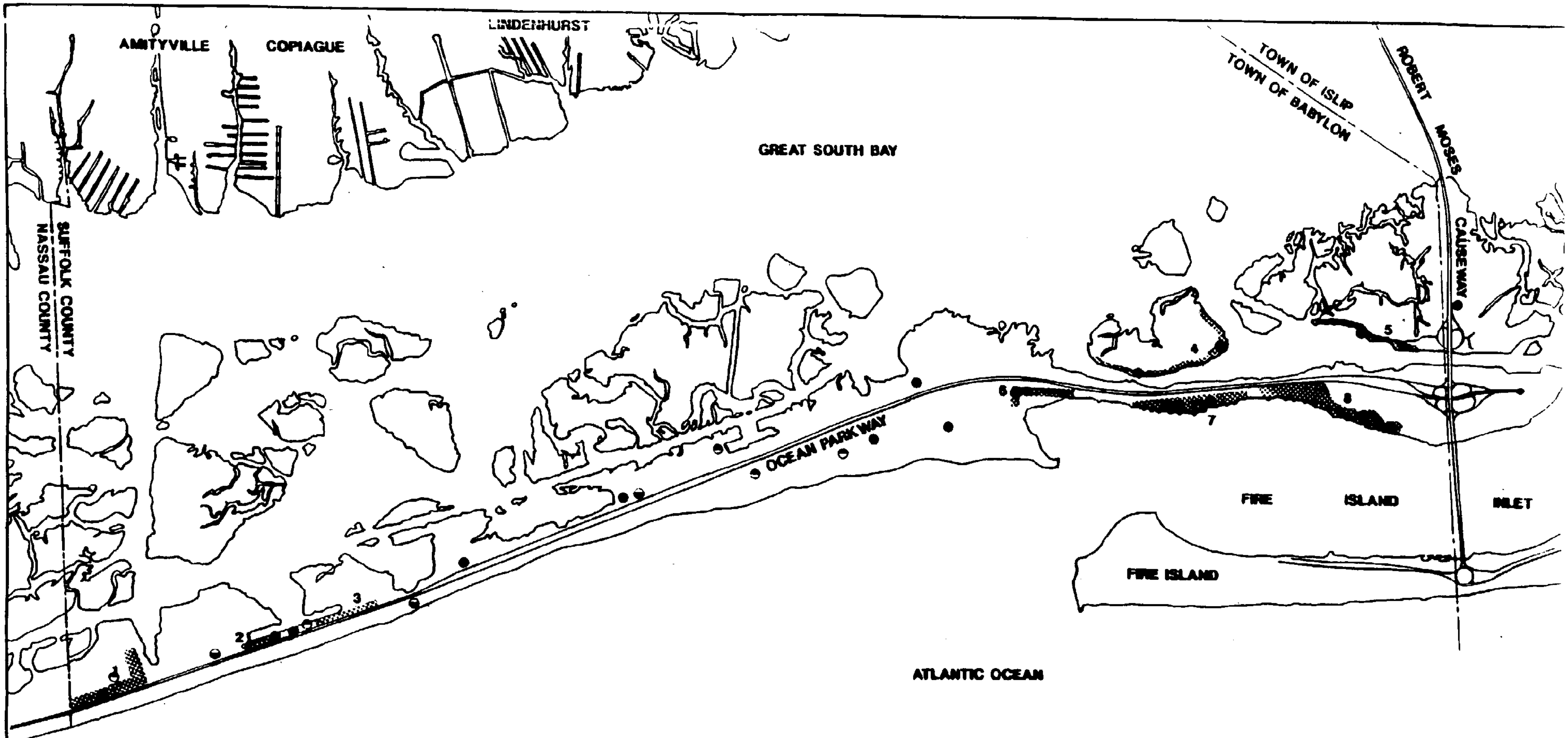


SOURCE : N. M. PERLMUTTER AND H. C. CRANDELL, 1959

FIGURE 3-1 HYDROGEOLOGIC CROSS-SECTION OF THE SOUTH-SHORE BEACHES OF WESTERN SUFFOLK

TOWN OF BABYLON **ENVIRONMENTAL STUDY** **BARRIER & BAY ISLAND COMMUNITIES**	**Cashin Associates, P.C.**



- PUBLIC SUPPLY WELLS
- U.S.G.S. WELLS
- E.E.A., INC. SAMPLE LOCATIONS

OUTER BEACH COMMUNITIES

1 WEST GILGO BEACH
2 GILGO BEACH WEST (UNASSOCIATED)
3 GILGO BEACH EAST (UNASSOCIATED)
4 OAK ISLAND
5 CAPTREE ISLAND (UNASSOCIATED)
6 OAK BEACH WEST (UNASSOCIATED)
7 OAK BEACH EAST (UNASSOCIATED)
8 OAK BEACH ASSOCIATION

FIGURE 3-2 LOCATIONS OF PUBLIC SUPPLY, U.S.G.S. AND E.E.A. INC. SAMPLE WELLS

TOWN OF BABYLON
ENVIRONMENTAL STUDY
BARRIER & BAY ISLAND COMMUNITE

Cashin Associates, P.C.

SECTION 4

SECTION 4
EROSION CONTROL AND FLOODING

SECTION 4

EROSION CONTROL AND FLOODING

4.0 INTRODUCTION

As already noted, the study area consists of six separate residential communities, which are located on the south shore barrier and bay island system in the Town of Babylon, Long Island, New York. Two of the subject communities (i.e., Oak Beach and Oak Beach Association) are located on the ocean side of the barrier, to the south of Ocean Parkway - actually, these communities front on Fire Island Inlet, rather than directly on the ocean. Two communities (i.e., West Gilgo Beach and Gilgo Beach) are located on the bay side of the barrier, to the north of Ocean Parkway. The remaining two communities (i.e., Captree Island and Oak Island) are located behind the barrier, on islands in Great South Bay. All six of these communities and the surrounding area are situated in designated flood hazard zones, due to the proximity of the ocean and the consequent vulnerability to coastal storms. The entire study area is also located either directly on or adjacent to a section of barrier beach that has experienced shoreline erosion in the recent past.

The following discussion opens with an overall examination of the coastal geology of the study area and the general consequences that severe storms can have in this type of geologic zone. The discussion then focuses on the history of coastal erosion and flooding in the study area, and the methods that have been used to control storm damage. The vulnerability of the land and structures in the study area to storm-induced damage is assessed, and a qualitative analysis is undertaken to determine if the development of the subject barrier and bay island communities has had a significant effect on the extent of coastal erosion and flooding that has occurred in the local area. Finally, possible measures to mitigate future damage are discussed.

4.1 GENERAL COASTAL GEOLOGY OF THE STUDY AREA

The study area comprises a segment of the chain of barrier islands and spits that stretches almost continuously along the Atlantic and Gulf coasts of the U.S., from Maine through Texas. Four distinct geologic/vegetative zones (i.e., beach, dune, back barrier, and bay islands), which are typical of barrier beach systems in general (Leatherman, 1982), are present in the study area. These zones, which are described individually in Sections 4.1.1 through 4.1.4, vary substantially from one another with respect to sediment and biological characteristics due to the differing energy levels of the geologic forces that operate.

The Oak Beach communities are located immediately adjacent to Fire Island Inlet, which is geographically the middle of five inlets that cut through the barrier beach on Long Island's south shore. The geologic processes that characterize this inlet, and the history of man's activities to control these processes, are discussed in Section 4.1.5.

4.1.1 BEACH ZONE

The south side of the barrier island in the study area fronts directly on the Atlantic Ocean (or on Fire Island Inlet), and is generally characterized by a gently-sloping, sandy beach that is essentially devoid of vegetation. Both the characteristics of the beach material (i.e., the relative homogeneity of the grain size, the roundness of the individual sand particles, etc.) and the lack of significant flora are due primarily to the frequent shifting of the substrate caused primarily by wave action in the high energy environment of the ocean shorefront. Wind also serves as an important agent of sediment transport on the beach.

On average, ocean waves strike the shoreline at an angle rather than head-on. Consequently, the wave energy has a distinct component that is directed parallel to the shore. This net long-shore component of wave energy gradually carries sand along the shoreline in a process that is commonly called littoral (or long-shore) drift. Along the beaches that front directly on the ocean (i.e., at West Gilgo and Gilgo Beaches) the long-term net direction of littoral drift is from east to west, as is true for most of Long Island's south shore. Evidence of the direction of movement of littoral sand along the oceanfront in the vicinity of the study area can be clearly seen on historical aerial photographs, which show that Democrat Point has migrated westward a distance of approximately 1,000 feet since the early 1900s. In the early 1800s, the western end of Fire Island was located in the vicinity of Fire Island Lighthouse, which is almost five miles from the present position of Democrat Point. The generally westward direction of littoral drift is also evident in aerial photographs of Jones Island, which show the accumulation of sand on the eastern (updrift) side of groins and jetties (see Section 4.5.2.B for further discussion). The volume of sand moved by the littoral drift system in the vicinity of Fire Island Inlet is estimated to be between 450,000 and 600,000 cubic yards per year (Cyril Galvin, 1985).

In contrast to Gilgo Beach and points to the west on Jones Island, the shoreline at Cedar Beach (situated immediately to the west of Fire Island Inlet and east of Gilgo Beach) has a west-to-east direction of long-shore transport due to the complex pattern of tidal currents in the vicinity of the inlet (Taney, 1961). Most of Oak Beach - which is located behind Fire Island, on Fire Island Inlet - also experiences a net eastward direction of littoral drift. This situation is evidenced by recent aerial photographs, which show that sand has accumulated on the west side of the series of groins that have been installed along this stretch of shoreline. Since sand collects on the up-drift side of these shore-perpendicular structures, the pattern of sand deposition in the Oak Beach groin field indicates that the long-shore movement is from the west. This reversal of the normal long-shore drift direction is due to a combination of the shielding effect of Fire Island (the wind fetch for waves with a westward component is much more restricted than for northeast-moving waves), the refraction of waves around Democrat Point, and the influence of tidal currents through the inlet.

Sediment budget analyses that have been conducted to quantify the volume of sand that is transported in littoral drift along Long Island's barrier indicate that the classic conveyer belt analogy for this process is not entirely accurate; not all of the sediment arriving at a given shoreline location can be accounted for by the material carried long-shore from the updrift beaches. A number of studies (summarized in Tanski and Bokuniewicz, June 1989) have indicated that sediment is transported on a long-term basis in an on-shore direction from the inner continental shelf. However, the magnitude of that transport has not been sufficiently quantified.

In addition to the continuous action of waves, the beach zone is subject to seasonal and episodic geologic forces. Seasonal variations in wave energy cause an annual cycle of onshore-offshore movement of beach sand. In the winter months, beach material is typically scoured and moved to offshore bars by high energy, short period waves generated during energetic storms. During the summer, sand tends to be carried onto the beach from the offshore bars due to the low height, long period waves that are characteristic of that season (Leatherman, 1982).

Because of the seasonal variation in the geologic forces operating on the oceanfront beach, the topographic profile of the beach can vary significantly during the course of a year. During the winter, the beach is typically steeper and narrower due to the erosional action of energetic storm waves. In the summer, the beach is generally characterized by an increased width and a gradual slope to the toe of the dunes, due to the onshore movement of sand. However, the summer beach profile can deviate significantly from this pattern, especially in response to storms, which may shorten and steepen the profile or even cut a steep scarp into the face of the beach. Similarly, a "typical" winter profile may not be achieved during a mild winter.

The beach, being the barrier island zone in closest proximity to the ocean, is most susceptible to the powerful forces that are unleashed during high intensity storms (i.e., hurricanes and northeasters). The beach zone serves as an important first line of defense for the back portion of the barrier island. Without a well-developed and stable beach acting as a buffer, the dunes and back-dune area would be more prone to storm-induced erosion, and the entire barrier would be more susceptible to breaching (i.e., a break-through that creates a new inlet).

Large segments of the oceanfront beaches within the study area (i.e., the stretch of the Jones Beach barrier island between its eastern tip and the Nassau County line) have experienced significant erosion during the recent past. In particular, the shoreline has receded steadily at Gilgo and West Gilgo Beaches during the time since the stone jetty was installed at Democrat Point in 1941, due primarily to the impact that this structure has had on local geologic processes. In contrast, Cedar

Beach has experienced rapid accretion during the same time period, due to the alteration of current patterns caused by the stabilization and dredging of Fire Island Inlet and related projects. The significant erosion that occurred along the Oak Beach shoreline prior to the 1960s was caused mostly by natural processes in Fire Island Inlet, rather than by activities associated with the navigation project (Cyril Galvin, 1985).

See Section 4.1.5 for further discussion of the impacts that engineering projects undertaken in Fire Island Inlet have had on adjacent beaches. Section 4.4.1 elaborates more fully on the history of shoreline erosion in the study area.

4.1.2 DUNE ZONE

The central portion of the subject barrier island contains a series of low, sandy dunes that are situated beyond the reach of normal wave activity. Dunes are shaped by coastal winds, with dune vegetation providing sand trapping capability. This vegetation, particularly dune grasses which are tolerant to salt spray and sand burial, gives dunes a great degree of stability against the effects of coastal erosive forces. The ability of dune grass to trap sand, while growing at a rate that prevents burial, is also essential to the process of dune growth (accretion) and the creation of new dunes. Artificial means (e.g., snow fencing and Christmas trees) are often used on dunes to enhance sand trapping capabilities.

In the study area, dune height varies, but was generally found to be about 10 feet, measured toe to crest (based on field measurements made by CA in October 1992). Along much of the length of barrier in the Town of Babylon, the width of the base of the dunes is restricted by the presence of Ocean Parkway, which serves as the landward limit of dune growth. In many locations the back slope of the dunes extends essentially to the edge of the parkway shoulder, especially in the West Gilgo Beach area. In some areas, the natural dune has been completely eroded away, causing serious concern about the future stability of Ocean Parkway and prompting emergency measures that have included the construction of "artificial dunes" (which are actually earthen embankments composed of loamy fill rather than typical dune sand) in those areas. Several sections of recently placed artificial dune, which total several thousand feet in length, have been placed along the segment of Ocean Parkway within the Town of Babylon. The segments of man-made dunes are characterized by a relatively consistent height of 12 to 14 feet; however, the protective capacity of these features is limited by a narrow base width, sparse vegetative cover, and mixed grain size.

The sections of native dune in the Gilgo Beach area have heights that generally vary between 8 and 12 feet. However, these dunes are characterized by a narrow base width, which has resulted from the erosional loss of beach material on the ocean side and the restriction of landward migration due to the presence of Ocean Parkway. The constricted width of the Gilgo Beach dunes and the erosional damage that has already occurred have diminished the ability of these features to withstand damage, including possible breaching, from surge during major storms.

Damage to the dunes caused by wave erosion has been widespread throughout the study area. The most severe recent erosion has occurred in the area between the West Gilgo and Gilgo Beach communities, where some sections of dunes have been completely washed away (see Section 4.3.2.E for a discussion of the effects of the 11-12 December northeast storm). Vertical scarps have been cut into the ocean face of most of the remaining line of native dunes at Gilgo and West Gilgo Beaches.

At Cedar and Overlook Beaches, dune height (again, measured toe to crest) is typically only 5 feet. However the elevation of the dune crest generally exceeds 15 feet above mean sea level (msl), based on the information in the USGS topographic quadrangle map, due to the steady accretion of sand to the beach in this area. In addition, a well-developed series of secondary dunes has formed behind the wide-based primary dunes. Thus, this stretch of shoreline contains the most stable section of dunes and provides the most effective erosion protection along the entire Town of Babylon barrier beach.

The dunes within the Oak Beach communities appear to have been significantly impacted by the construction of houses at that location. Most of the waterfront home sites are located within the primary dune zone. To a large degree, dune disturbance has extended into the area surrounding the houses. Vestiges of dunes that exist between the houses are generally low in height and poorly developed. To the immediate east of the Oak Beach Association, in contrast, is a fully developed dune system, although portions of this area have been impacted by pedestrian traffic.

Despite being discussed here as an distinct entities, dunes and beaches are integrally tied to one another. In particular, a significant long-term loss of material from the buffering beach will invariably also lead to significant adverse effects on the adjacent dunes. This point is clearly illustrated by recent events at Gilgo and West Gilgo Beach. The steady loss of beach material along that stretch of shoreline has exposed the dunes to the full force of storm waves, with the inevitable result being extensive erosion of the dunes and the consequent threat to Ocean Parkway. Additionally, since the beach serves as a primary source of sand that is deposited on the dunes, dune accretion would be stunted (or completely halted) in the absence of a significant width of beach.

Dunes are the most important natural protective feature on the barrier island. However, storms waves, aided by the rise in base water level due to storm surge, do occasionally penetrate the dune line to cause storm wave impacts to reach the back barrier area. Overwash is the process by which surging storm waves break over the dune crest and penetrate through the dune line. Overwash is the primary mechanism by which sand is carried from the shorefront to the back dune area, and is an important factor in the process by which the barrier migrates in a landward direction in response to sea level rise (see Section 4.7). The creation of a new inlet, which is essentially an extreme instance of overwash, involves the breaching of the barrier down to an elevation below mean sea level.

Although overwash and inlet creation are processes that occur naturally in even the most unspoiled barrier system, man's impacts can increase the potential for the occurrence of these events. As shown in Figure 7.1, numerous paths have been cut through the dunes on the Town of Babylon barrier beach due to pedestrian traffic originating to the north. Although these footpaths are typically only a few feet in width, they represent potential sites for future overwash or blowout (i.e., wind-induced scouring which ultimately results in a well-defined break in the dune line). Other activities which cause damage to dune vegetation (such as the clearing of dune grass) or which cause the beach to become narrowed (such as the construction of groins or jetties updrift from a given location) would reduce the stability of the dunes and, as a result, would increase the likelihood that a future storm will breach the dune line and adversely affect the back barrier area.

4.1.3 BACK BARRIER ZONE

The portion of the barrier island on the back side of the dunes is generally afforded some degree of protection from the most severe effects of coastal storms. However, as discussed in Section 4.1.2, the back barrier area can be impacted by overwash events. Further, the back barrier area is not immune from the effects of flooding from the bay side caused by storm surge.

Due to the protected environment created behind the dune, the geology and vegetation of the bay shoreline are vastly different from those that characterize the oceanfront. The low energy area along the bayward shore of the barrier island in the study area is dominated by salt marshes, interspersed with some short segments of sandy beach where nearshore tidal currents and waves are strong. In the days prior to the enactment of the New York State Tidal Wetland regulations, some areas of salt marsh on the back barrier in the study area were filled and bulkheads were installed along the shoreline to retain the fill material. Other human activities, such as dredging and the installation of docks, have also resulted in the loss of some areas of salt marsh.

Salt marshes along the bayward shore of a barrier island typically originate on a sandy substrate that is created by overwash or as sand deltas associated with former inlets. Over time, the quiet environment of the back barrier allows fine-grained, organic-rich sediments (silt and clay) to accumulate into a layer of peat. The growth of marsh grasses provides stability to the marsh and causes the marsh to grow upward and outward into the bay, similar to what has been described previously with respect to the effect that dune grass has on the process of dune accretion (Leatherman, 1982).

Although the prominent zone of the back barrier is generally the salt marsh, a transition zone, called the barrier flats, may also be present. The barrier flats, which occupy the area between the dunes and the salt marsh, are typified by negligible relief (generally less than six feet above msl) and lack of topographic features. The substrate in the barrier flats is sandy, having been derived primarily from overwash events and wind-blown sand (Leatherman, 1982). The vegetative assemblage of this zone can vary greatly, depending on the frequency of overwashes. Within the study area, the barrier flats vary greatly in width and have been modified to a large extent by man-made structures, such as residential development, recreational facilities, and roadways.

4.1.4 BAY ISLANDS

Two processes have served as the source of the sandy substrate which forms the base of bay islands in the study area. Some bay islands have been formed by means of natural geologic processes, while other islands are entirely or partly artificial, having been created during the disposal of dredge spoil or other fill material.

Natural bay islands form on lobes of overwash sand behind the barrier island and on delta sands deposited on the bay side of former inlets (Leatherman, 1982). Marsh vegetation becomes established in the same manner as has been described previously for the back barrier marshes (see Section 4.1.3), forming a layer of peat atop the sandy base. The surface of natural bay islands is generally at sea level (or slightly above msl), since the sediment that forms this surface is deposited from tidal inundation. However, a low upland area can exist in the central portion of islands which have been derived from washover events. Captree Island, Oak Island, Cedar Island, and Gilgo Island are examples of natural landforms, although some were connected to Jones Island prior to the original dredging of the State Boat Channel.

Bay islands that form by natural processes can be modified to a significant degree by human actions. Elevated areas often exist on such islands due to the placement of fill (e.g., the parkway embankment on Captree Island, and the residential areas of both Oak and Captree Islands) or the disposal of dredge spoil (e.g., the northeast corner of Captree Island, along Snakehill Channel).

A number of bay islands in the vicinity of the study area have been created entirely by artificial means through the disposal of sandy dredge material removed from nearby navigation channels. Such artificial islands have typically been formed so that the central portion of the island is well above msl. For example, Grass Island has a maximum elevation of approximately 16 feet above msl, while the Ox Island and East Nezaras Island both have a maximum elevation of slightly less than 15 feet above msl. Salt marshes often have formed around the intertidal fringes of these man-made bay islands.

4.1.5 FIRE ISLAND INLET

Fire Island Inlet is geographically the middle of five inlets that penetrate the barrier beach on the south shore of Long Island, with Rockaway and Jones Inlets located to the west, and Moriches and Shinnecock Inlets located to the east. Jones Beach barrier island (Jones Island) lies to the west of Fire Island Inlet, while Fire Island lies to the east.

Fire Island Inlet, like Rockaway Inlet to the west, is classified as a complex inlet on the basis of its shape and dynamics. In contrast to the simple inlets (i.e., Jones, Moriches, and Shinnecock), which cut in a more or less perpendicular line through the barrier, Fire Island Inlet runs in a general east-west direction, parallel to the beach.

The distinction in the orientation of simple and complex inlets is due to a difference in the patterns of sediment deposition and erosion. At simple inlets, the rate of sand deposition into the inlet from the updrift side is approximately the same as the rate at which the downdrift side is eroded away. Thus, a simple (unstabilized) inlet has a tendency to migrate in a downdrift direction while maintaining its shore-perpendicular orientation. At Fire Island Inlet, in contrast, the rate of sand deposition on the updrift side has exceeded the rate of erosion of the downdrift side. As a result, Fire Island has grown in a westward direction and has overlapped the eastern end of Jones Island by approximately four miles.

Historical information regarding Fire Island Inlet has been summarized in numerous sources (Cyril Galvin, July 1985; Kassner and Black, 1983 and 1984; and Woods Hole Oceanographic Institute, 1951), and is briefly discussed here. Fire Island Inlet is reported to have first opened in 1690. Shoreline surveys conducted between 1834 and 1939 show that while the western side of the inlet remained essentially stationary over that period of time, the eastern side of the inlet experienced a dramatic change. During that time period, Democrat Point migrated westward a distance of approximately 3.8 miles, although that rate of accretion was not constant. Fire Island began to overlap Jones Island in about 1873.

Bathymetric surveys conducted in the years prior to the construction of the rock jetty at Democrat Point indicated that the position and shape of the natural navigation channel through Fire Island Inlet varied over time. A 1909 survey indicated that the channel was essentially straight, and was located offshore and parallel to Oak Beach. By 1924, the channel had reverted to an S-shape, which was also observed during a 1834 survey, and had shifted northward. This latter channel configuration directed tidal currents toward Oak Beach and caused significant erosion of the shoreline at that location (see Section 4.4.1.B for a discussion of the Oak Beach erosion problem).

The Army Corps of Engineers (ACOE) conducted the first stabilization feasibility study of Fire Island Inlet in 1906, at which time it was concluded that, although the installation of a jetty would improve navigation, such a project would not fix the position of the channel. However, after further analyses the ACOE issued a report in 1937 which recommended that a 5,000-foot jetty be constructed along Democrat Point, on the east side of the inlet. It was anticipated that the proposed jetty would accomplish the multiple objectives of stopping the westward growth of Fire Island, stabilizing the position of the inlet channel, and arresting the chronic erosion at Oak Beach. However, this structure, which was completed in 1941, has failed to achieve any of the desired goals. The jetty's effect on the position of Democrat Point was only temporary; the jetty reached its storage capacity by 1948, at which time littoral sand began to bypass into the channel and Fire Island recommenced its westward growth. The jetty also has not provided any significant help in maintaining the position or depth of the channel; large shoals typically form within six months of the completion of a maintenance dredging operation, creating a substantial hazard to navigation. Additionally, Oak Beach continued to experience erosion after the inlet was "stabilized", especially when shoaling around the jetty pushed the channel to the north and shifted high velocity tidal currents in closer proximity to the Oak Beach shoreline. Furthermore, the interruption of the westward long-shore drift caused by the jetty, which was intended to prevent the shoaling of the inlet channel, created an unwanted side effect; the interruption of the flow of littoral sand has caused substantial erosion to beaches located west of the inlet, particularly at Gilgo and West Gilgo Beaches, which were not previously subject to unusual erosion (see Section 4.4.1.A).

As noted above, shoaling of the navigation channel typically commences shortly after maintenance dredging is completed. These shoals tend to form at both ends of the dredged channel, as ebb and flood tides redistribute sand carried westward from Robert Moses State Park by the action of long-shore drift. As a result of this continuous transport of sand westward across the jetty, regular maintenance dredging is necessary to fix the position of the navigation channel through Fire Island Inlet. This dredging program is overseen by the ACOE.

Dredge spoil obtained from Fire Island Inlet has been used to restore the beaches to the west of the inlet since 1959. The feeder beach (i.e., the location of dredge spoil placement) is selected on the basis of technical analyses so that no more than 10 percent of the fill material is carried back toward the inlet (i.e., 90 percent or more is carried westward by long-shore drift). Generally, the feeder beach stretches along several thousand feet of Gilgo Beach. In 1960, the ACOE recommended that a permanent sand bypassing plant be installed at Fire Island Inlet to convey sand to the erosion-prone beaches to the west of the inlet. This project has never been implemented.

The ACOE has used a number of different configurations for the dredged channel through Fire Island Inlet. Channel length, width, and position with respect to Democrat Point have all been varied over the years since the initial maintenance dredging operation was completed in 1954. Dredging was undertaken on an almost annual basis between 1954 and 1970. Following an approximately three-year lull in project activities, maintenance dredging was performed three times between 1973 and 1977. After the 1977 contract work was completed, Fire Island Inlet dredging was halted by a legal action brought by residents of Oak Beach (see Section 4.4.3 for additional discussion of this issue). The lawsuit was settled in the ACOE's favor; maintenance dredging was started again in 1988, and has been undertaken bi-annually since then. Historically, dredge spoil from the State Boat Channel has also been used to nourish the Beach on Jones Island, although the last such project occurred in 1969.

4.2 SEVERE COASTAL STORMS

4.2.1 THE ORIGIN AND CHARACTERISTICS OF SEVERE COASTAL STORMS

Coastal storms that affect Long Island fall into two general categories: hurricanes and extratropical storms (i.e., midlatitude cyclones, locally known as "northeasters"). Although these two types of storms can cause a similar level of devastation to developed coastlines, they are vastly different with respect to origin and progression.

A. ***Hurricanes***

Hurricanes typically originate as low pressure "waves" in the lower atmosphere over West Africa (Stevens, 1990). As such waves are carried by prevailing winds over the eastern Atlantic Ocean, they can develop into tropical disturbances, which are weak atmospheric low pressure systems lacking strong winds, with cloudiness and some precipitation. For reasons that are not fully understood, such tropical disturbances occasionally gain strength to eventually become hurricanes as they are moved by the trade winds westward across the Atlantic. The hurricane designation is applied when the sustained wind speed exceeds 74 miles per hour (120 kilometers per hour). The term "tropical storm" is applied to a storm which has winds of 37 to 74 mph (60 to 120 km/hr), which either has not developed into a hurricane or has weakened from hurricane strength.

Hurricane strength is commonly expressed in terms of the Saffir/Simpson scale, which is listed below (from LIRPB, 1984). This classification is based on ***sustained*** wind speed; wind gusts for a given storm can be significantly stronger.

Category 1 - 74 to 95 mph (120 to 153 km/hr)
Category 2 - 95 to 110 mph (153 to 177 km/hr)
Category 3 - 110 to 130 mph (177 to 209 km/hr)
Category 4 - 130 to 155 mph (209 to 250 km/hr)
Category 5 - greater than 155 mph (greater than 250 km/hr)

Due to the fact that winds circulate in a counterclockwise pattern around hurricanes, the winds on the eastern side of the storm center would blow onshore (i.e., in a southerly direction) as the storm approaches Long Island from the south. Conversely, the western side of the storm would have offshore winds. In addition, the forward movement of the storm is additive to the wind direction on the eastern side of the storm, but partly offsets the winds on the western side of the storm. As a result of these factors, flood elevations, the magnitude of storm waves, and ground-level wind velocities are generally greater on the eastern (right) side of a northward-moving hurricane than on the western (left) side.

The energy that drives the winds of a hurricane is derived from the heat stored in the tropical ocean (Eagleman, 1980). For this reason, the occurrence of hurricanes is limited to those months of the year during which ocean temperature is highest (i.e., typically in August, September, and October, but also occasionally in June, July, and November, and rarely in May and December). Energy that a hurricane absorbs from the ocean through the evaporation of tropical surface waters is released via condensation as air rises rapidly through the low pressure vortex at the storm's center. This cycling of energy, from evaporation to condensation and back again, intensifies and sustains the storm. Once a hurricane moves over land, and becomes removed from its source of energy, the storm rapidly weakens. The condensation that occurs in the upper levels of hurricanes produces the torrential rains that are typically associated with these phenomena.

Although a hurricane will travel in a generally westward direction across the Atlantic Ocean, the exact path followed can vary greatly, especially in the western Atlantic. Hurricanes will be directed by the position of weather systems, and in particular will tend to skirt high pressure centers. As a result, depending on the specific weather patterns that exist at the time of any given hurricane, the path can lead to Mexico or Central America, the Gulf or Atlantic coasts of the U.S., or even out into the North Atlantic avoiding landfall altogether (Eagleman, 1980).

Hurricanes typically move forward in the low-latitude open waters of the Atlantic at a speed in the range of 12 to 19 mph (20 to 30 km/hr). Although this slow rate of movement usually allows the existence of a hurricane to be identified several days to a week or more before the storm reaches land, the uncertainty of predicting the precise path of the storm usually does not allow meteorologists to accurately identify the location of greatest hazard until shortly before actual landfall.

Importantly, hurricanes typically gain in forward speed as they move over the colder waters of the higher latitude reaches of the Atlantic. For example, the 1938 hurricane that struck Long Island was moving northward at approximately 51 mph at landfall, while Hurricane Gloria (1985) was traveling at a speed of approximately 43 mph at landfall (NYS Emergency Management Office, January 1992). Such fast-tracking storms exacerbate the problems inherent in identifying the expected landfall location and undertaking appropriate preparations and evacuation procedures. Furthermore, rapidly advancing hurricanes have a larger difference in wind velocity between the right and left sides of the storm, which increases the potential for damage on the right side compared to a slower moving storm of the same category.

While it is clear that the 1970s and 1980s were a relatively quiet period for hurricane activity along the Eastern and Gulf coasts of the U.S., recent scientific evidence indicates that the next two decades may spawn hurricanes at an increased frequency and strength. According to information presented in a March 25, 1990 article of the *New York Times* (Stevens, 1990), the historical incidence of strong hurricanes in the western North Atlantic can be linked to long-term weather conditions in West Africa, where hurricanes originate. Recently, the trend has been toward wetter weather in West Africa, which has been correlated with an increased probability of strong hurricanes. Furthermore, the gradual rise in ocean surface water temperature linked to global warming has increased the amount of heat energy available to sustain hurricanes in the North Atlantic. It is believed that the occurrence of Hugo (which struck St. Croix, Puerto Rico, and South Carolina in 1989), Bob (which glanced off the east end of Long Island and struck Rhode Island and Massachusetts in 1991), and Andrew (which struck south Florida and Louisiana in 1992) in unusually rapid succession was largely the result of the aforementioned climatic conditions.

B. ***Extratropical Storms (Northeasters)***

"Northeaster" is a local term applied to a mid-latitude (extra-tropical) cyclonic storm, which like a hurricane, is centered at a low pressure cell around which winds blow in a counterclockwise direction. The factors that contribute to the formation of mid-latitude cyclones are complex and can vary significantly from event to event. However, such storms typically originate in the western U.S. and intensify due to lower atmospheric interactions with the jet stream (Eagleman, 1980).

The prevailing westerly winds across the continental U.S. carry mid-latitude cyclones in a generally eastward direction. However, as with hurricanes, the positions of other weather systems and the jet stream have an important influence on storm track, often causing the storm to veer northward along the Eastern Seaboard. A mid-latitude cyclone that follows the coastal track along the eastern U.S. will often travel from its point of origin to Long Island within several days. Additionally, storm strength is highly sensitive to the vagaries of meteorological conditions. These factors confound the task of forecasting coastal impacts for this class of storm.

The greatest potential for mid-latitude cyclones to cause coastal damage along the Eastern Seaboard generally arises during storms that veer northward or northeastward along the Eastern Seaboard, which is a fairly common track (e.g., the Halloween 1991 and 11-12 December 1992 storms). At the leading edge of a storm of this type, the winds blow from the northeast, thus giving rise to the common name applied to these phenomena. These storms can occur at any time of year, although storm intensity is typically significantly greater during the late fall and throughout the winter. Mid-latitude cyclones are generally less intense than hurricanes, but usually move more slowly (or can stall altogether) and cover a much larger geographic area. Consequently, in comparison to a hurricane, a severe northeaster is characterized by a longer time period of damaging impacts (often extending a period of over several tidal cycles) and a wider area of destruction. For these reasons, the overall adverse effects of these two types of storms are similar.

4.2.2 FACTORS AFFECTING THE SEVERITY OF COASTAL STORMS

The extent of damage caused by any given coastal storm is affected by a number of parameters. To a large extent, the magnitude of destruction is related to the storm's physical characteristics, such as wind velocity, amount of precipitation, and storm duration. However, as described below, some of the variables having the greatest influence on the degree of storm-related damage occurring in coastal areas are not directly associated with the physical parameters of the storm itself (LIRPB, 1984).

The stage of the astronomical tide at which a storm strikes will have an enormous effect on the storm's overall impact. Much more extensive flooding and a deeper inshore penetration of damaging storm waves will result from a storm that occurs at astronomical high tide (and especially during spring high tide, at full and new moons) than from an identical storm that strikes at low tide. The occurrence of sustained winds and surge that drive flood waters into a restricted embayment behind a barrier can lead to a phenomenon known as "ebb surge", which involves the sudden rush of floodwaters back into the ocean. If the volume of water that flooded into the bay was great, the force of the ebb surge can have dramatic impacts, including intense erosion and structural damage. The barrier beach in the study area would be especially prone to ebb surge impacts due to the relatively expansive width of Great South Bay, which allows this embayment to accommodate a larger volume of water during the flood surge compared to similar bays along the Eastern Seaboard (Coch and Wolff, 1990). Coch and Wolff (1991) also noted that bulkheads are particularly prone to failure caused by the force of the ebb surge.

The design of shoreline construction will have a significant effect on the degree to which such structures will withstand the energetic forces that are unleashed during a severe storm; structures which have been constructed according to the latest standards of hurricane-resistance will be more likely to survive intact. The intensity of land use in the coastal zone also affects the extent of damage that can occur, in terms of monetary losses; obviously, the potential for disastrous property damage is greater in a densely developed area than on undeveloped lands, although the extent of geologic damage (i.e., erosion, landform alteration, etc.) may actually be less severe in developed areas where shoreline protection has been constructed. The state of community preparedness at the time of a storm is also an important factor affecting the extent of damage; in general, the prior implementation of appropriate measures will significantly abate storm damage.

While it is true that wind and heavy precipitation can cause storm-related damage to both inland and coastal areas, the latter area is uniquely subject to the additional destructive forces of storm waves and coastal flooding. All six residential communities which comprise the study area, as well as the entire surrounding area of the barrier and bay islands, are located within an area that has been identified as being prone to coastal flooding.

Coastal flooding (i.e., flooding resulting from the incursion of marine waters onto inland areas, rather than from the accumulation of runoff due to precipitation) is caused by storm surge and storm waves. Storm surge is a mound of water that is created by the physical forces within a storm, particularly the powerful winds associated with the storm. In addition, the low pressure cell at the center of the storm creates a partial vacuum that draws water (and air) inward. Wind-driven storm waves increase the flood water elevation above the level that would result from the stillwater condition alone.

Surge and waves during a strong coastal storm typically have the most destructive impact on individual structures, often resulting in the complete obliteration of entire buildings. However, the force of storm winds, especially during hurricanes, often causes the most widespread damage. The extensive damage on Long Island in 1985 due to Hurricane Gloria was caused mostly by the wind. The devastation caused in 1992 by Hurricane Andrew in southern Florida and Louisiana in 1992 was also due primarily to wind damage (DeHenzel, FEMA, October 6, 1992, telephone communication).

A. *Still Water Flooding*

The portion of the waterfront that can be impacted by still water coastal flooding due to storm surge during the 100-year storm (i.e., the storm event which occurs once per 100 years, on average) has been designated as the "area of special flood hazard". The area of special flood hazard includes both the A and V zones as indicated on the Flood Rate Insurance Maps (FIRMs), which have been created by the Federal Emergency Management Agency (FEMA). The A zone comprises that area that would primarily experience still water flooding during the 100-year storm, while the area within the V zone would also be subject to significant storm wave action.

The A zone encompasses a much larger area than the lands that are included in the V zone. The greater expanse of the A zone is accounted for by the fact that storm surge causes the water level to rise behind the barrier, as well as on the ocean side. Thus, areas on the back barrier and bay islands that are protected from direct wave attack, are not similarly protected from damage caused by the flooding that accompanies a severe storm.

Base flood elevation (BFE) is defined as the average estimated water level (above msl) that would exist within a given flood zone during the 100-year coastal flood, as determined through scientific analyses that were conducted by FEMA. The BFE of a given location, which is reported on the FIRM, is an important parameter in defining the degree of vulnerability to flood damage. Besides being a straightforward assessment of the approximate flood height within a given zone during the 100-year event, the BFE also indicates the general susceptibility of a given area to more frequent flooding during less intense storms, with higher values of BFE tending to occur in more flood-prone areas that are in closer proximity to the shoreline. Importantly, however, the degree to which structural flooding tends to occur also depends strongly on grade elevation and building characteristics. Obviously, a property situated at an elevation that is only slightly above msl would be subject to more frequent flooding and higher flood levels (relative to grade elevation) than a property located on higher ground within the same flood zone. Similarly, a building that is constructed on pilings would be less susceptible to flooding than another building constructed on a slab at the same grade elevation.

Actual patterns of flooding can vary somewhat from the relative values of BFEs that are indicated on the FIRMs. For example, the mainland coastal area can experience a greater degree of flooding than the barrier, even though the latter area has higher BFE values. This apparent inconsistency is due mostly to grade elevation considerations; properties along the mainland shoreline tend to be situated on fill that is elevated only a few feet above sea level, while a large portion of the development on the barrier island is located on back dune areas which have substantially higher elevation. Furthermore, whereas surge waters can bypass the barrier by flowing through inlets, no such bypass route exists as the surge is pushed against the mainland. Thus, for certain storm events, flood elevations (relative to msl) along the mainland shoreline can actually be slightly higher than water heights on the barrier island. Regardless of these patterns of potential still water flood damage in the Town of Babylon, however, it is important to note that the barrier island is generally considered to be <u>more</u> susceptible to significant storm damage than the mainland due to the potentially destructive impact of high energy storm waves (see the following discussion).

See Section 4.3 for specific discussion of the vulnerability of the study area to coastal flooding during severe storms. Section 4.4.1.A describes legislation, regulations, and standards that pertain to construction in the A zone. See Plates 1A through 1G for the geographic extent of the A zone in the study area and vicinity.

B. ***Storm Waves***

Although stillwater flooding caused by coastal storms can impact a large area of land on both sides of the barrier, including wide stretches of the mainland waterfront, the area that is potentially affected by the energetic waves generated by winds during hurricanes and "northeasters" is much more restricted in extent. In general, storm wave damage is a significant concern only for land in the immediate vicinity of the oceanfront. However, the presence of an inlet or the absence of an adequate line of protective dunes on the barrier are some of the conditions under which the destructive power of storm waves can penetrate to the bay.

The area of the potential influence of storm waves is designated as the "V" (i.e., "velocity") zone on the FIRMs and is called the "coastal high hazard area". The extent of the V zone has been delineated on the basis of scientific and engineering studies, and encompasses that area of land within the special flood hazard zone which would be subject to breaking waves of three feet or greater height during the 100-year storm event. FEMA's three-foot wave criteria is based upon U.S. Army Corps of Engineers analyses, which have indicated that the energy of a breaking wave of this height is the minimum capable of causing major damage to conventional wood frame structures (FEMA, June 1987).

It is important to note that the potential for storm wave damage does not abruptly cease at the inland boundary of the V zone. Residual storm waves (of less than three feet in height) can penetrate further inland during the 100-year storm. Additionally, storm wave penetration and associated impacts would be carried further inland during a storm event with a greater period of recurrence than 100 years (e.g., the 500-year storm).

As discussed above, the V zone comprises the region of greatest hazard with respect to severe coastal storms. Consequently, structures that are erected in the V zone should be constructed according to the highest standards of wind and storm wave resistance. During a severe storm, those houses within the V zone that lack proper construction are much more likely to sustain significant damage or even total destruction due to the combination of elevated water level and the pounding of storm waves (Coch and Wolff, 1990 and 1991). In contrast, structures within the A zone typically sustain only water damage during such events, although a poorly anchored house can be subject to floatation and subsequent destruction due to impact with other structures.

See Section 4.3 for further discussion of the vulnerability of the study area to storm waves. Section 4.5.1 describes legislation, regulations, and standards that pertain to construction in the V zone. See Plates 1A through 1G for the geographic extent of the V zone in the study area and vicinity.

C. ***Flood Zone Designations***

As discussed above, FEMA has subdivided the area of special flood hazard into two primary zones: the A zone, which is characterized mostly by still water flooding during the 100-year storm; and the V zone, which is also subject to potential storm wave damage. Subcategories have been created within each of these major designations. As shown on the FIRMs, a one-digit or two-digit number is included with the letter designation of each flood zone (e.g., V11, V9, V8, V6, A4, and A6). This number indicates the overall Flood Hazard Factor of a given zone, which is the average weighted difference between the water surface elevations of the 10-year and 100-year storm events. Thus, the numeric value for a flood zone designation indicates the intensity of the base flood event (i.e., the 100-year storm) compared to the degree of flooding that occurs during the 10-year storm.

Actuarial insurance rate tables are established on the basis of a number of factors. Both the letter and numeric values of the flood zone designation are utilized, along with the base flood elevation, to establish the overall degree of hazard within a zone. Building construction is also an important parameter; houses that comply with FEMA's structural requirements for flood damage mitigation (see Section 4.5.1) will be assessed a lower premium than those houses that are in non-conformance, since the former group would be more likely to withstand a major storm.

4.3 VULNERABILITY OF THE STUDY AREA TO COASTAL FLOODING

4.3.1 FLOOD ZONE DESIGNATIONS AND BASE FLOOD ELEVATIONS WITHIN THE SUBJECT COMMUNITIES

The flood zone designations and the base flood elevations (BFEs) for the subject communities are described below, and are shown on the maps in Plates 1A through 1G. BFE, as reported on the FIRMs and discussed in Section 4.2.2.A, represents the estimated average height to which floodwaters would be elevated above msl during the 100-year storm event. Unless otherwise noted, all elevations are in feet above msl, referenced to the National Geodetic Vertical Datum of 1929.

Only the FIRMs for Oak Beach and the Oak Beach Association depict the location of houses, which corresponds closely to the aerial photographs. This map information facilitated determining the flood zone designation of individual houses and transferring the flood zone boundaries from the FIRMs to the aerial photographs for these two communities (see Plates 1E through 1G). The developed area of Captree Island is contained entirely within a single flood zone and, consequently, the lack of house locations on the FIRM for this community did not hinder the transfer of flood zone information to the aerial photograph (Plate 1D). The developed portion of Oak Island is split between two flood zones; however, the location of the boundary between these two zones was easily transferrable to the aerial photograph on the basis of distinctive shoreline geography (Plate 1C). In contrast, the FIRM that depicts both Gilgo Beach and West Gilgo Beach not only lacked house locations, but also did not accurately depict shoreline geography or the location of roadways. Consequently, the positioning of the flood zone boundaries on the Gilgo and West Gilgo aerial photographs (Plates 1A and 1B) was subject to some degree of uncertainty.

CA measured grade elevations and first floor elevations for 390 of the 415 houses in the subject communities during the field investigation of the study area. Elevation measurements were recorded using a 5X magnification bubble level (readable to a distance ±100 feet) and a standard 15-foot surveying rod. A more precise instrument (i.e., a transit) was not used due largely to the time constraints of the study. Furthermore, the use of a transit was not warranted by the objective of this investigation, which was to assess overall community conformance with BFE rather than to determine whether individual houses are in conformance.

Data that were provided by the Town of Babylon Department of Environmental Control, as compiled from the Town's records of property surveys for building permit applications submitted since 1980, were used as the "benchmark" elevations from which CA's field measurements were made. These data consisted of the tax map location, and first floor and grade elevations for approximately 60 houses. The use of existing formal benchmarks was not feasible given the methodology of this investigation; these benchmarks have been installed at scattered locations along Ocean Parkway, and are at least several hundred feet from the nearest point of the subject communities.

Detailed grade elevation information for the Oak Beach communities was obtained from a series of two-foot interval topographic maps that were compiled by Topo-Metrics, Inc. (1980). These data were used by CA to determine the grade elevation of individual houses, as supplemented and verified by field measurements using the bubble level and rod.

Most of the houses in the study area have enclosed space at-grade, below the BFE. However, the FEMA regulations allow certain uses (i.e., parking, storage, and entryways) below the level of the occupied first floor in the flood plain. Therefore, the presence of enclosed space below BFE does not necessarily mean that a given house is not in compliance with FEMA's elevation requirements. To ensure that this factor was taken into consideration, CA conducted an external inspection during the field survey to determine whether the lowest level of each house was being utilized for an allowable use. This assessment was based on the general construction and condition of the enclosed space, the appearance of windows, the type of entryways, and other visual clues. For example, if the enclosed space at-grade did not appear to be weatherproofed, it was deemed to be a compliant use and that house was judged to be elevated above grade. If the space appeared to be suitable for habitation, even on an occasional basis (e.g., including such uses as recreation rooms, workshops, offices, etc.), it was deemed to be a non-compliant use and that house was judged to be situated on-grade. In any case where uncertainty existed as to the use of an enclosed space at-grade, the house was deemed to be at-grade. All first floor heights were measured directly from grade level using the surveying rod.

The survey which is described above focused strictly on the assessment first floor elevation within the subject communities. A comprehensive engineering evaluation of the degree of compliance with FEMA's other structural requirements, particularly with respect to the stringent standards for houses in the V zone, was not included in the scope of this study. However, the elevation data that were provided by the Town of Babylon regarding building permits issued for construction in the study area since 1980 can be used to estimate the maximum degree of full compliance with FEMA standards. These data indicate that of the ±336 houses in the V zone within the subject communities, only 18 units have been constructed or reconstructed since 1980 and are in compliance with their respective BFE requirements. If it is assumed that houses erected or reconstructed prior to 1980 do not comply with FEMA's V zone building standard, it can be concluded that no more than 5 percent (i.e., 18/336) of the houses in the V zone within the study area are in full compliance with the requirements of FEMA. The actual degree of full compliance at the present time is probably less than 5 percent, since it is likely that some of the BFE-conforming houses constructed after 1980 do not meet FEMA's other construction standards. However, as houses are reconstructed in the future, the degree of full compliance would be expected to gradually increase (approximately three houses which were under construction at the time of the field surveys for this study were being elevated on typical V zone pilings).

Below is a description of flood zone designation and BFE within each of the six residential communities in the study area.

A. ***West Gilgo Beach***

The West Gilgo Beach Association is situated entirely within the V zone. Most of the area in this community is located within the V11 zone (BFE = 12 feet). The area comprising the northerly leg of the leased land, along Bay Walk, is located mostly within the V6 zone (BFE = 9 feet). Elevations were recorded at 48 of the 64 houses within the V11 zone and at all 16 of the houses within the V6 zone.

West Gilgo Beach has been sited upon fill which has raised grade elevation at the house sites to an average of approximately 4.9 feet in the V6 zone and approximately 7.1 feet in the V11 zone. Most of the houses in this community are slab-on-grade construction. Only ±29 percent of the houses in the V11 zone and ±25 percent of the houses in the V6 zone appeared to have unoccupied space on the lowest level and, therefore, conform with FEMA's requirements for first floor elevation. The remaining houses, which appeared to have non-conforming uses on the first floor, lie as much as 4 feet below BFE in the V6 zone and as much as 6 feet below BFE in the V11 zone (see Figures 4-1 and 4-2).

B. ***Gilgo Beach***

The Gilgo Beach communities are on lands that are also situated entirely within the V zone. The V11 zone (BFE = 12 feet) includes essentially all of the area to the south of the interior roadway, as well as most of the Gilgo Beach West leased lots to the north of the roadway. The V6 zone (BFE = 9 feet) includes the eastern group of three lots situated to the north of the interior roadway at Gilgo Beach West, as well as the entire leased area at Gilgo Beach East (which is also located north of the roadway). Elevations were recorded at 21 of the 22 houses in Gilgo Beach East and at all 35 homes in Gilgo Beach West.

Grade elevation for the 32 houses in the V11 zone at Gilgo Beach West varies from 3.7 feet to 7.2 feet, averaging 5.7 feet. Thirty of these houses are situated more or less at-grade, with only three of the 30 appearing to have conforming uses on the first floor. The first floor elevation of the 27 houses which appeared to have occupied space at grade lies more than 4 feet, and as much as 7 feet, below BFE. The first floors of only five houses appeared to be elevated above BFE and, therefore, comply with FEMA's elevation standard (see Figure 4-3).

The three houses at Gilgo Beach West that lie within the V6 zone are of slab-on-grade construction, with ground elevation varying between 4 and 6 feet. This translates to a first floor elevation that lies between 3 and 5 feet below BFE.

Ground elevation at the house sites at Gilgo Beach East varies between 1.3 and 3.8 feet, with a average of 2.2 feet. Essentially all the houses have been placed on pilings. Three houses have an occupied first floor elevation of 9 feet or greater, which conforms with FEMA's elevation standard. Figure 4-4 shows that the first floor elevation of the remaining 18 houses lies between 1 and 6 feet below BFE, with a difference in the 3 to 5-foot range being most common.

C. **Oak Island**

The entire southern shore of Oak Island is located within the A6 zone (BFE = 8 feet). The V6 zone (BFE = 9 feet) comprises the residences along the eastern shore of Oak Island, but not including the house at the southeastern point and the two houses on either side of the tidal creek just north of that location (these three houses are situated within the A6 zone). All 54 houses on Oak Island were surveyed for elevation.

Ground elevation in the A zone portion of the Oak Island community varies from 2 to 15 feet, and averages 4 feet. As shown in Figure 4-5, there is a wide variation in first floor elevations in this area. Approximately 68 percent of these houses comply with the 8-foot FEMA standard for BFE. Most of the non-complying houses are situated at the eastern end of the community.

Ground elevation in the V zone portion of the Oak Island community varies within a narrow range of 2 to 4 feet, and averages 3 feet. The first floor elevation of all seven houses is below the 9-foot BFE for this zone, with the difference ranging between 1 and 5 feet below BFE (see Figure 4-6).

D. *Captree Island*

The developed area of Captree Island is located entirely within the A6 zone (BFE = 8 feet). Elevations were recorded at 27 of the 32 houses in this community.

Ground elevation for the Captree Island houses included in the survey varies between 5 and 11 feet, and averages 5.5 feet. As shown in Figure 4-7, first floor elevation of these residences exhibits a wide variation. Approximately 67 percent of the houses comply with the 8-foot FEMA standard for BFE. Most of the non-complying houses are situated at the western end of the community.

E. ***Oak Beach (Unassociated)***

Most of the developed lots in the unassociated portion of Oak Beach are situated within the V9 zone (BFE = 10 feet). The home sites at the western end of Oak Beach and those in a band on the north side of the community are located in the V8 zone (BFE = 9 feet). Elevations were recorded for 118 houses, 80 within the V9 zone and 38 within the V8 zone, of the 120 houses in Oak Beach.

Grade elevation of the house sites in Oak Beach varies from approximately 3 feet to 12 feet in the V8 zone and from approximately 5 feet to 10 feet in the V9 zone, averaging 6.3 feet in the V8 zone and 6.5 feet in the V9 zone. Most of the houses in this community contain enclosed space at grade; however, external inspection indicated that the majority of these enclosed areas contain conforming uses (e.g., storage, garages, and entryways). Thus, a large portion of the houses are considered to be elevated above grade.

The first floor elevation of the houses in Oak Beach varies from ±4 feet to ±19 feet in the V8 zone, and from ±5 feet to ±18 feet in the V9 zone (see Figures 4-8 and 4-9). In the V8 zone, 77 percent of the houses appeared to have a first floor elevation that is greater than the 9-foot BFE, with 72 percent having a first floor elevation of 10 feet or greater. In the V9 zone, 54 percent of the houses appear to have a first floor elevation that is greater than the 10-foot BFE.

F. ***Oak Beach Association***

The Oak Beach Association is located almost entirely within the V8 zone (BFE = 9 feet). Although some developed lots located to the north of The Fairway are situated partially within the A6 zone (BFE = 8 feet), all of the existing houses on these lots are in the V8 zone. Elevations were recorded at 69 of the 72 houses in this community.

Grade elevation of the house sites in the Oak Beach Association varies from approximately 3 feet to greater than 12 feet, averaging 6.2 feet. Most of the houses in this community contain enclosed space at grade, which appeared from external inspection to consist largely of non-conforming uses (e.g., uses other than storage, garages, or entryways).

Thus, the first floor of these houses are generally not elevated to a significant degree above grade.

The first floor elevation of the houses in the Oak Beach Association varies from ±3 feet to ±18 feet (see Figure 4-10). Approximately 28 percent of the houses appeared to conform with the 9-foot BFE requirement. The first floor elevation of 55 percent of the houses appeared to be a foot or more below BFE.

G. *OVERALL COMPLIANCE WITH BASE FLOOD ELEVATION REQUIREMENTS*

As noted previously, CA field surveyed the first floor elevation of 390 of the 415 houses in the study area. FEMA's requirement for the BFE of these houses ranged from 8 feet for Captree Island and most of Oak Island, to 12 feet in most of West Gilgo Beach and Gilgo Beach West. Compliance with the respective BFE standards varied significantly within the study area, from a high of 77 percent of the surveyed houses in Oak Beach's V8 zone, to 68 percent in Oak Island's A6 zone and 67 percent on Captree Island (which have the lowest BFE of all six communities), to total non-compliance in Oak Island's V6 zone. Overall, of the 390 houses that were measured, 42 percent appeared to be in compliance with the applicable BFE standard.

4.3.2 HISTORICAL OCCURRENCES OF FLOODING IN THE STUDY AREA

A. *Overall Storm Frequency and Severity*

Historically, severe coastal storms have struck in the vicinity of the study area fairly frequently. According to an analysis of historical storm data performed in the Hurricane Damage Mitigation Plan for the South Shore of Nassau and Suffolk Counties (LIRPB, 1984), the approximately 120-mile stretch of shoreline from Shinnecock Inlet on eastern Long Island to Barnegat Inlet in New Jersey was estimated to have an 85 percent probability of experiencing at least one tropical storm (including hurricanes) over a ten-year period, and a 50 percent probability of experiencing a hurricane over a ten-year period. According to the LIRPB analysis, that same region of the New York Bight has an 81 percent probability of experiencing at least one extra-tropical coastal storm during any given year.

The effects that recent hurricanes and northeasters have had on the study area are illustrated below through descriptions of the coastal flooding and storm damage that occurred due to the 1938 hurricane (Subsection B) and the 11-12 December 1992 northeaster (Subsection E). Hurricane Gloria (Subsection C) and the Halloween 1991 northeaster (Subsection D) are also briefly discussed.

B. *1938 Hurricane*

The 1938 hurricane is generally acknowledged as having been the most severe storm to strike the study area (and, actually, all of Long

Island) during the last century. Various sources indicate that the eye of the storm crossed Long Island between Patchogue (NYS Emergency Management Office, January 1992) and Westhampton (Coch and Wolff, 1990; and Pore and Barrientos, 1976). Sustained winds at landfall on the afternoon of September 21, 1938 were reported to be 96 mph (SEMO, January 1992), which qualified the storm only as a low category 2 hurricane. However, the extent of flooding was magnified by a number of factors, including: a track oriented almost due north, resulting in a near-perpendicular landfall; a forward speed of 51 mph, which significantly increased wind speeds and surge heights on the storm's right side; arrival near high astronomical tide during the moon's closest approach to earth, which increased still water flood levels; and high levels of precipitation. Despite the synergistic effect of this combination of factors, it is important to note that landfall occurred 16 to 34 miles to the east of Fire Island Inlet, which resulted in the study area being exposed to the weaker (left) side of the storm. The extent of flood damage inflicted to the subject communities would probably have been substantially greater had landfall occurred to the west, which would have caused the stronger (right) side of the storm to come ashore at Jones Island.

According to an account published in *The Beacon* (Douglas, 1990), the 1938 hurricane caused houses at Oak Beach to be lifted from their foundations and carried inland distances of 200 feet or more. In all, it was estimated that about 50 houses were either destroyed in-place, washed away, or moved from their foundations, with most of these houses, however, being repaired before the end of 1938. The boardwalks at Oak Beach were almost completely washed away, and large slabs of concrete were "...undermined and toss[ed] about...". Due to the tremendous volume of surge water that rushed through the underpass at Gilgo Beach, the Gilgo Inn was washed from its foundation and carried to the eastern end of the boat basin, a distance of about 700 feet. The marginal road at Oak Beach was reported to be under eight feet of water - since the elevation of this roadway generally varies between four and five feet, the surge height at this location is estimated to have been approximately 12 to 13 feet above msl (which is consistent with the 11-foot surge height reported at Fire Island Inlet by Coch and Wolff, 1990). Only one fatality resulted at Oak Beach, and few bodily injuries were sustained; however, only about 50 people were present in the community at the time of the storm.

It is important to note that the devastation caused by the 1938 hurricane was not limited to the study area. Damage was intense on an Island-wide scale. Forty five lives were lost in Nassau and Suffolk Counties. Flood waters inundated approximately 35,000 acres between Fire Island Inlet and Montauk Point. On Fire Island alone, 1,000 homes were damaged or destroyed. Structural damage was even more severe along the stretch of barrier in Westhampton Beach (in eastern Long Island); only about 15 percent of the original 179 summer homes remained standing, of which only about 7 percent were deemed to be salvageable (LIRPB, 1984). Long Island's south shore barrier beach was breached by a total of ten new inlets (Coch and Wolff, 1990).

C. ***Hurricane Gloria (September 27, 1985)***

While Hurricane Gloria was traveling up the Eastern Seaboard, meteorologists predicted that Long Island would be severely impacted, with coastal erosion and flood damage expected to equal or exceed the devastation caused by the 1938 hurricane. Although the eye of Gloria passed directly over Fire Island Inlet on an almost shore-normal track, the storm had deteriorated to a category 2 hurricane, passed quickly, and reached landfall approximately at low tide. Overall damages caused across Long Island by Hurricane Gloria were relatively extensive, but most of this destruction was wind-induced. Coastal erosion and flood damage was much less severe than anticipated.

D. ***Halloween 1991 Northeaster***

Although the Halloween 1991 northeaster was generally not as severe as the 11-12 December 1992 storm, some areas of Long Island suffered significant erosion during the former event, particularly along the north shore. However, information provided during informal discussions with residents of the study area indicate that the subject communities were not seriously affected by the earlier storm. Consequently, the discussion of impacts from northeasters focuses on the more destructive 1992 storm, as follows.

E. ***11-12 December 1992 Northeaster***

Nassau and western Suffolk Counties have not been greatly affected by coastal flooding due to hurricanes since the 1938 storm. However, the same cannot be stated with respect to the impacts of extratropical cyclones. In general, more severe coastal flooding and erosion damage has been caused by northeasters than by hurricanes (e.g., the November 1950 and Halloween 1991 storms). Preliminary reports from the Town of Babylon (Hanse, December 14, 1992, telephone communication; and Kluesener, December 14, 1992, telephone communication) on the 11-12 December 1992 northeaster, as well as observations made during field reconnaissance by CA on December 12 and 15, 1992, are used here to illustrate the magnitude of storm damage in the study area due to this particularly intense northeaster.

The Fire Island Inlet dredging/beach nourishment project was in progress in December 1992, and approximately 0.8 million cubic yards of dredge spoil (out of a total planned volume of 1.2 million cubic yards) had been placed on Gilgo Beach at the time the northeaster struck (Hawkins, ACOE, December 21, 1992, telephone communication). Although the newly widened beach provided an adequate protective buffer and prevented significant erosion of the adjacent dunes, the sand that was pumped onto the beach was almost completely washed away by storm waves. Dune erosion was severe at the West Gilgo Beach ocean shoreline, which had not been nourished directly during the dredging operation and had not yet begun to receive the benefit of sand moved westward from the spoil disposal area by littoral drift. Sheer scarps approximately six to eight feet in height were cut into most of the West Gilgo dune line, and only the back slope of the dune remains. The loss of dune material at this location has resulted entirely from toe erosion, whereby storm waves washed material from the base of the dune, causing the overlying dune sediment to slide down to the beach.

More severe storm impacts were sustained by the segment of dunes approximately 1,000 feet in length to the east of the West Gilgo Beach underpass. Only the flat area of dune vegetation behind the original dune crest remains at this location. Evidence of two minor washovers (i.e., small fans of sand extending behind the original dune line) was observed in the middle portion of this shoreline section. However, essentially all of the loss of dune material in this area was caused by toe erosion.

Complete dune washout occurred along most of the approximately 3,000-foot long segment of shoreline extending westward from the Gilgo Beach community. Scattered segments of artificial dune (consisting of loamy fill material) have been deposited in this area, but substantial gaps remain. These gaps in the line of man-made embankment consist of portions of the grassy shoulder of the parkway and small remnants of the flat area of dune vegetation behind the original dune crest. It is apparent that some dune washover occurred. However, as with the less eroded line of dunes to the west, the loss of dune material was caused primarily by toe erosion.

Flooding occurred at a number of locations within the residential communities of the Outer Beach, particularly at Gilgo Beach, and Oak and Captree Islands. Minor flooding occurred to the easternmost row of houses at West Gilgo Beach. The Oak Beach communities did not suffer from coastal flooding; however, severe stormwater flooding blocked the access road to the unassociated portion of Oak Beach.

Although the full extent of flood damage is not known at this time, it has been reported that the flood waters penetrated the first floor of a number of houses situated at grade in Gilgo Beach, and Oak and Captree Islands. One house on the south shore of Oak Island appears to have been shifted from its foundation. Water marks were observed on the siding of several houses during supplemental field surveys, indicating a flood elevation of approximately 5 to 6 feet above msl at both the ends of the Gilgo Beach community, and a slightly higher flood elevation at Captree Island. Bulkheads in these two communities were more or less intact, although accessory timber structures (e.g., decks and fences) were heavily damaged.

Oak Island was not visited during CA's December 1992 field inspections. However, visual observations made from the north shore of Jones Island revealed that, except for the one house that had been shifted on its foundation, there was no evidence of major structural damage to the residences. The boardwalk that had stretched along the entire length of the island's south shore was severely damaged; large sections of the walkway were obliterated, leaving only the pilings.

While the 11-12 December 1992 northeaster caused relatively minor flood damage to the Town of Babylon's Outer Beach communities, much of coastal Long Island did not fare as well. This storm, which was dubbed "the 100-year storm" by some meteorologists, caused severe flood damage and erosion at numerous locations, including Bayville and Asharoken on the north shore, and Fire Island and Westhampton Beach on the south shore barrier beach. Mainland communities along the north shore of Great South Bay and South Oyster Bay were also extensively flooded.

The 11-12 December 1992 northeaster demonstrated the uncertainties that are inherent in forecasting the effects of coastal storms. The full moon occurred on December 9, and tides were still near the lunar high levels on the 10th. Initially, the National Weather Service predicted that the storm would move inland in the vicinity of Chesapeake Bay, far to the south of the study area. When it was clear that the storm was tracking on a more northward course, a coastal flood watch was issued for the Long Island shoreline. Even though flooding was expected, however, the speed with which the waters inundated coastal communities was unusually rapid. Further, the initial storm winds were from the east, which pushed water into the western end of Great South Bay and increased surge levels in that area. Winds approached hurricane strength during the height of the storm and did not significantly subside until the storm slowly progressed into New England. These persistent winds prevented floodwaters from draining from the bay into the ocean during the astronomical ebb tide. The duration of the storm, over four full tidal cycles, was a major factor in the extent of flood damage; many areas took a continuous pounding over the course of two full days.

4.3.3 ASSESSMENT OF POTENTIAL FLOOD DAMAGE IN THE STUDY AREA

A. ***Building Construction***

As discussed in Section 4.3.1, a large number of the houses in the study area do not conform with the minimal requirements of FEMA with respect to first floor elevation. On the basis of these data, therefore, it appears that there is a high probability for the occurrence of widespread flooding in the subject communities during major coastal storms. Further, since a very low percentage of homes in the V zone portion of the study area conform with FEMA's structural standards, the potential is great for extensive damage to occur due to storm surge and wave action caused by a severe storm event.

Information gathered by CA through informal conversations with residents of the study area indicates that the residential communities on Babylon's barrier and bay islands have experienced relatively minor storm-induced flooding during the period of time that the present homeowners have occupied their houses. This information contrasts with the FIRMs, which show that entire study area is located within the 100-year floodplain (although some scattered lots are situated at an elevation above BFE). Since this study has not revealed any evidence to suggest that the FIRMs overestimate the extent of the 100-year floodplain, it is valid to assume that the FIRMs accurately depict the extent of flooding that would occur in the study area during the 100-year storm. Consequently, it is reasonable to conclude that the history of recent storm-induced flooding in some communities in the study area does not accurately reflect the susceptibility of these communities to inundation.

B. *SLOSH Surge Model*

The possible height of flood waters that would result from hurricanes striking Long Island has been estimated as part of the State of New York Hurricane Evacuation Study, which utilized the Sea, Lake and Overland Surge from Hurricanes (SLOSH) computer model. This model was used to simulate the surge level that would be induced by category 1 through 4 hurricanes, assuming worst-case combinations of storm direction, forward speed, and landfall point at a series of reference locations scattered throughout the coastal zone. Importantly, because worst case conditions were used in the model at each reference location, the computed surge level represents the estimated <u>maximum</u> possible flood elevation for each hurricane category.

Elevations given by the SLOSH model are computed in terms of storm surge height above msl. Variations in flood water elevation due to the astronomical tide level are <u>not</u> accounted for by the model. Thus, if a storm strikes during astronomical high tide, the expected flood level would be increased over the SLOSH value by approximately four feet at Democrat Point, and by less than a foot at most locations within the interior of Great South Bay.

As part of the Hurricane Evacuation Study, two reference locations were modeled on Jones Island in the vicinity of the subject communities: just offshore at the Cedar Beach pavilion, and just offshore at the western end of Tobay Beach. The maximum surge elevations, in feet above msl, for category 1 through 4 hurricanes at these locations are given below.

	Cedar Beach	Tobay Beach
Category 1	7.9	8.2
Category 2	13.4	13.3
Category 3	17.0	18.3
Category 4	23.8	24.1

Maximum inundation conditions were used in the SLOSH surge model because the primary objective of the Evacuation Study was to ensure that evacuation shelters are sited out of the reach of possible storm flooding (McDuffie, U.S. Army Corps of Engineers, November 1992). The actual flood elevation that would be experienced during a hurricane of a given category within the study area would most likely be less than the SLOSH value. Because a hurricane of category 4 (or even category 3) is a rare event for Long Island, the chances are remote for any given location to experience the exact conditions defined by the scenario of maximum flooding for SLOSH category 4 (or category 3). The FIRMs indicate that the ocean shore front along Gilgo Beach has a BFE of 15 feet. Thus, the flood levels modeled for the worst case category 2 hurricane (13.4 feet at Cedar Beach and 13.3 feet at Tobay Beach) are slightly less than the elevation of the 100-year storm. The category 3 maximum flood levels, therefore, are representative of a storm with a recurrence interval of greater than 100 years.

The SLOSH model has also been applied to simulations of actual storm conditions. For example, this model was used to depict the surge patterns caused by Hurricane Hugo, based on data collected on the storm's direction, forward speed and landfall point. According to the investigators in that study, the results of the modeling analysis fairly accurately portrayed actual surge conditions, as represented by field measurements of surge elevation at numerous locations (Coch and Wolff, 1991).

C. ***Public Preparedness for Severe Storms***

The level of public preparedness is one of the most important factors affecting the extent of damage caused by severe coastal storms. Due to the tremendous energy generated by their winds, hurricanes have the greatest potential for catastrophic coastal destruction from storm surge. Consequently, public preparedness is most crucial with respect to minimizing the impacts of hurricanes. However, extratropical storms can cause also widespread flood damage (e.g., the Halloween 1991 and 11-12 December 1992 storms). Therefore, although the following discussion focuses on public preparedness for hurricanes, this information is also pertinent with respect to northeasters.

Public preparedness, as used here, can be defined simply as the likelihood that the residents of the subject communities will respond appropriately in the event of a hurricane. Ultimately, the preparedness of these residents can only be put to a full test in the event of a storm that requires evacuation. However, the groundwork for ensuring a successful public response to a hurricane disaster must be well-established prior to an impending landfall. In geographic areas, such as Long Island, for which severe hurricanes are relatively infrequent, the task of maintaining a suitable level of preparedness can be problematic.

The prevailing opinion among scientists and officials of government agencies who specialize in hurricane preparedness, as expressed at a November 1992 conference on this topic held at Hofstra University in Hempstead, New York, is that Long Island residents are decidedly unprepared for the next "big one". Conversations with some of the residents of the Babylon barrier and bay island communities that were conducted during the course of this study underscored the opinions expressed by the experts at the Hurricane Conference. The residents' perception is partly based on personal experience in which none of the storms that have struck the barrier beach in the recent past have inflicted significant destruction to the subject communities. In fact, several storms which were forecast as having the potential for causing major damage (especially Hurricane Gloria and, most recently, Tropical Storm Danielle in September 1992) turned out to be substantially weaker than anticipated.

The lessons of Hurricane Hugo seem to be particularly pertinent to the public perception of potential hurricane hazards, in general. Prior to 1989, the residents of coastal South Carolina had become accustomed to relatively weaker hurricanes. However, "never again" was the most common response given in post-storm interviews by residents who, on the basis of their prior experience with hurricanes, decided to ride out Hugo at home (Coch and Wolff, 1990).

One major factor that contributes to a generally underwhelming public concern with respect to the potential hazards of coastal storms in the study area is the reality of local geography, which places the subject communities on the left side of the eye in almost every possible hurricane scenario. Although, as discussed in Section 4.2.1.A, the left side of a hurricane typically has less severe wind and surge conditions, the left side is by no means immune from devastating impacts. The observations made by Coch and Wolff (1991) subsequent to Hurricane Hugo are very instructive in this regard. Folly Island, located to the south of Charleston, was struck by the left side of the hurricane; however, storm damage at that location was comparable to areas that were on the right side of the eye. The underlying cause of this unexpectedly high level of storm damage at Folly Island was a high long-term erosion rate due to the updrift interruption of long-shore transport caused by the Charleston Harbor jetties. This situation is analogous to the conditions that exist along the ocean shoreline in the study area, which has suffered a long-term erosion problem caused by the updrift loss of sand at Fire Island Inlet.

D. *Evacuation Planning*

The public's response to a hurricane threat has clearly and conclusively been shown to vary with the specific circumstances of the threat and with the public's perception of the information provided by government officials and the media (NYS Emergency Management Office, August 1991). In order for an evacuation order to be heeded, therefore, the government officials who are responsible for issuing such directives must have previously established a relationship of trust with the public. Since this relationship can be compromised by the occurrence of "false alarms", government officials are generally hesitant to order an evacuation unless there is a clear need for such action.

The total time required for full evacuation of some Long Island communities is estimated to be in excess of 20 hours (Lewis, November 1992); this maximum evacuation time applies to certain Fire Island communities, which have no land surface transportation link to the mainland. Coch and Wolff (1990) estimated that full-scale evacuation of Long Island's barrier beach communities would take at least 12 to 18 hours. An evacuation of the Outer Beach communities in the Town of Babylon can be completed in six hours (Hanse, October 1993).

Due to the uncertainty in forecasting landfall location and because of the speed at which hurricanes generally travel up the eastern U.S. coast (see Section 4.2.1.A), therefore, evacuations typically have to be commenced before meteorologists can pinpoint an expected Long Island landfall location with reasonable accuracy. Because of these factors, residents of the Outer Beach communities may be asked (or ordered) to evacuate at a time when a storm appears to be relatively unthreatening. This situation may prompt the residents to postpone leaving or to completely ignore the evacuation directive, especially in light of the relatively benign nature of recent coastal storms in the study area.

In a conversation that occurred during the field work for this investigation, one resident of the study area described his method for deciding whether to evacuate as involving a walk across Ocean Parkway to directly observe sea conditions. It is suspected that other members of the subject communities would likewise be inclined to remain at home until local conditions become more hurricane-like, regardless of the nature of information that is conveyed through official channels. However, one important consideration which is not accounted for in this wait-and-see approach is that evacuation from the Outer Beach is not simply a matter of reaching the mainland; evacuees must travel to a safe inland/upland area. Residents who postpone their departure from the barrier and bay islands are more likely to encounter flooded or debris-blocked evacuation routes and other conditions that delay or even prevent their arrival at a safe area. During a worst-case category 4 hurricane, for example, surge-induced flooding may extend as far north as Sunrise Highway (according to the SLOSH mapping that was performed in connection with the New York State Hurricane Evacuation Study).

4.4 VULNERABILITY OF THE STUDY AREA TO COASTAL EROSION

The portion of Jones Island on which the subject communities are situated has experienced significant erosion in the recent past, due mostly to the effect of severe coastal storms on this sand-starved segment of shoreline. Clearly, this portion of the barrier beach is vulnerable to further erosion in the future. The overall vulnerability of the study area and vicinity to continued erosion is discussed below in terms of the expected continuation of shoreline retreat (Section 4.4.1) and the potential for barrier breaching (i.e., inlet creation - Section 4.4.2).

4.4.1 VULNERABILITY OF THE STUDY AREA AND VICINITY TO SHORELINE RETREAT

A. *Ocean Shorefront*

The ongoing erosion problem along the ocean shorefront in the study area vicinity has been discussed in detail in previous sections of this report (e.g., Sections 4.1.1, 4.1.2, and 4.1.5). A summary of that information is presented below.

The ocean shorefront in the study area vicinity has retreated rapidly since construction of the Fire Island Inlet jetty was completed in 1941. The material that has been lost from this beach has generally been transported either offshore (via the normal process of seasonal shoreline profile adjustment) or to the west (via long-shore drift). Beach nourishment activities associated with the Fire Island Inlet dredging project have been undertaken in an attempt to restore sand that has been lost through erosion. However, in recent years the volume of sand supplied through beach nourishment has not kept pace with the volume of sand that has been eroded from the beaches. This overall sediment deficit has resulted in a net retreat of the shoreline towards Ocean Parkway.

Recent storms (especially the Halloween 1991 and 11-12 December 1992 northeasters) have accelerated the loss of sand from Gilgo and West Gilgo Beaches. Despite the 1989 resumption of beach nourishment activities on approximately a bi-annual basis after more than a decade without action on the Fire Island Inlet dredging project (see Section 4.4.3 for a discussion of the circumstances surrounding this hiatus), the barrier is extremely vulnerable at the present time. The beach is very narrow and dunes in many locations have been severely impacted. These conditions have increased the probability of breaching (see Section 4.4.2), have increased the probability that future storms will cause erosion that inflicts serious structural damage to Ocean Parkway, and have diminished the storm surge protection that the beach and dunes afford to the back barrier area.

Two primary mechanisms have been established to mitigate and remediate the continuing erosion problem along the ocean beach adjacent to the study area. The Fire Island Inlet dredging/beach nourishment project provides sand replenishment to the beach on a semi-regular basis (see Section 4.1.5). In addition, an inter-agency plan has been implemented to restore the dunes along Ocean Parkway on an emergency basis; this plan was formulated by the State Emergency Management Agency and the New York State Office of Parks, Recreation and Historic Preservation (see Section 4.5.3.B). Both of these projects are essential to combating erosion along the affected section of shoreline; however, due to the extent of shoreline retreat that has occurred to date, even the optimal implementation of these projects would not guarantee that the Gilgo and West Gilgo Beach shorelines would be able to withstand future storms.

B. ***Oak Beach***

The Oak Beach shoreline experienced a significant erosion problem during the years between 1930 and 1960. As noted in Section 4.1.5 (and discussed in detail in the Report by Cyril Galvin, 1985), the shoreline recession that occurred during this time period has been attributed primarily to tidal current scouring when the natural inlet channel was positioned in close proximity to the beach. Prior to 1935, the Town of

Babylon installed a series of timber groins along Oak Beach in an effort to trap littoral sand and retard beach erosion; however, these structures did not achieve the intended objectives and were destroyed. The stone groins that are present along much of the Oak Beach shoreline were originally installed by the Long Island State Parks Commission in 1959.

In May 1946, New York State, the Town of Babylon, and Suffolk County collaborated on a project in which sand was dredged from the inlet and placed on Oak Beach. The newly nourished shoreline was planted with beach grass. However, within six months the channel shoaled and the fill material was eroded by strong tidal currents and waves. Supplementary beach nourishment was conducted by the Long Island Parks Commission between 1946 and 1955, including the placement of sand fencing and additional beach grass plantings. Although these measures reduced the rate of erosion by half, shoreline recession at Oak Beach continued.

In 1959, the U.S. Army Corps of Engineers (ACOE) constructed a sand dike extending approximately one-half mile southward from the shoreline at the westernmost end of Oak Beach. This artificial finger of land, which became known as the "Sore Thumb", was reinforced on its western side with concrete rubble in about 1960. After the Sore Thumb was completed, the beach width at Oak Beach was augmented through large volume sand placement operations undertaken separately by the ACOE and the Long Island State Parks Commission.

An analysis of field data conducted by Cyril Galvin, Coastal Engineer (1985) indicates that the shoreline at Oak Beach was stable during the period between 1961 and 1980, neither retreating nor accreting to a significant degree. The shoreline at Oak Beach also appears to have been stable during the last decade, although the extensive field surveys that were undertaken in the past have not been continued in recent years (Hawkins, ACOE, November 12, 1992, telephone communication).

The abatement of coastal erosion at Oak Beach since 1960 is clearly related to the role that the Sore Thumb has played in deflecting tidal currents away from the beach. Although constructed by the ACOE with Federal funds as part of the Fire Island Inlet dredging project, the State of New York is responsible for the maintenance of this feature (Hawkins, ACOE, November 12, 1992, telephone communication). Recent storms have caused substantial erosion to the tip of the Sore Thumb (Hanse, Town of Babylon, December 21, 1992, telephone communication).

The Long Island State Park Commission (LISPC) is the NYS entity that would be responsible for overseeing maintenance work that may be performed at the Sore Thumb. However, the LISPC has indicated that they are currently occupied by other, more pressing erosion control problems in the vicinity of the study area (e.g., remediating the loss of significant beach width at Gilgo and West Gilgo Beaches, and at the Robert Moses State Park traffic circle). Given the current fiscal constraints that exist at the State level, it is likely that maintenance of the Sore Thumb will be delayed, and it is possible that this work will be neglected altogether (Hyland, LISPC, December 28, 1992, telephone communication).

4.4.2 VULNERABILITY OF THE STUDY AREA VICINITY TO BARRIER BREACHING

Historical maps and aerial photographs of Jones Island indicate that a number of additional inlets have existed along the stretch of barrier beach in the vicinity of the study area (Taney, 1961). Gilgo Inlet was present during the 1800s and into the early 1900s at a point approximately 400 feet east of the eastern end of the present Gilgo Beach community, including a period during the 1870s when two closely-spaced inlets had formed at that location. Oak Inlet (also known as Cedar Island Inlet) was present just to the west of the present location of the Sore Thumb on maps drawn in 1927 and 1935. Zach's Inlet was depicted at the present terminus of Wantagh Parkway on a 1909 map.

As discussed in Section 4.1.2, the opening of new inlets is a natural phenomenon that is a relatively common consequence of intense coastal storms. During the 1938 hurricane, ten new inlets were cut through Long Island's barrier beach. Inlet creation can have drastic direct impacts on development on the barrier beach. For example, a northeast storm that occurred in March 1962 cut a new inlet into Moriches Bay and washed out eight structures (LIRPB, October 1984).

Although tidal flow through newly created inlets is usually insufficient to prevent the channels from shoaling, which typically results in the gradual closure of these inlets, this is not always the case (e.g., Moriches Inlet). Furthermore, a number of adverse conditions generally develop during the period of time that a new inlet (whether temporary or permanent) is in existence. One primary impact is the loss of sand from the littoral drift system due to deposition in the tidal deltas of the new inlet. Another important impact is the augmentation of the tidal exchange between the ocean and the bay, which causes an increase in the tidal range and salinity in the bay. Amplified tidal range causes elevated high water levels, during both typical and storm conditions, which increases the probability of flooding in low-lying coastal areas. Additionally, the tidal exchange through a new inlet tends to diminish the flow through existing inlets, which results in increased shoaling and an escalation in maintenance costs for dredging operations. Increased salinity can have drastic effects on biological communities in the bay, especially valuable shellfish resources.

It is expected that a breach through Jones Island would cause a dramatic increase in the tidal range in Great South Bay. Fire Island Inlet, being a high-friction, shore-parallel inlet, greatly dampens the magnitude of the tidal head as it enters the bay. As a result of this factor, the tidal range presently decreases from approximately 4 feet at the westernmost tip of Democrat Point, to less than 1 foot at interior portions of the bay (Section 2.1). A newly created inlet, in contrast, would be cut perpendicularly through the barrier island. This configuration would offer much less resistance to the progression of the tidal head into Great South Bay, which would increase the total volume of water entering the bay during a flood tidal cycle (Buttner and Sanders, 1992).

The potential for an inlet to be created during a major storm is dependent upon a variety of parameters, many of which are difficult to accurately assess (e.g., the storm flood and ebb surge hydrography that would result from any given storm). Consequently, identifying sites that may be prone to breaching is subject to a high degree of uncertainty. However, according to Coch and Wolff (1991), one factor that appears to have been influential in the occurrence of breaching along the South Carolina coast during Hurricane Hugo was the width of the barrier; breaches were more common along narrow portions of the barrier islands, in both natural and developed areas. Furthermore, those same investigators found that natural dunes are more resistant to erosion than artificial dunes, primarily due to the greater extent of stabilizing vegetation on natural dunes, but also because the sand grains in natural dunes are typically more tightly packed than the sediment comprising artificial dunes.

Based on the information provided by Coch and Wolff (1991), the most likely sites of the formation of a future inlet through the Town of Babylon barrier island are along those sections of Gilgo and West Gilgo Beaches that adjoin southward extensions of Great South Bay, such as the Amityville Cut (West Gilgo boat basin), Gilgo Heading (Gilgo boat basin), and the coves in Gilgo State Park. These segments of the barrier island are also vulnerable to breaching due to the narrow width of the beach and the deteriorated condition of the dunes that are found there. The dunes in these areas are particularly vulnerable to breaching due to widespread, moderate to severe erosion (including sections that have been completely obliterated and have been replaced by man-made embankments), as well as numerous pedestrian paths that have been cut over the dune crests (see Sections 5.1.4 and 9.2.4).

4.4.3 EFFECT OF THE SUBJECT COMMUNITIES ON EROSION IN THE STUDY AREA

One aspect of the history of events in the study area concerning the residents of the subject communities has directly impacted the implementation of erosion control measures along Jones Island. The dredging of Fire Island Inlet was halted in 1977 due to a lawsuit that was brought by residents of Oak Beach, claiming that the removal of sediment shoals from the vicinity of Democrat Point accelerated the rate of erosion at Oak Beach. Due to the legal procedures and technical studies that were needed to resolve this dispute, the Army Corps of Engineers (ACOE) did not receive authorization to recommence the dredging project until 1988 (actual dredging did not begin until 1989). The scientific basis for dismissing the residents' lawsuit was established through report that was issued in August 1986 by the ACOE (Kraus, et.al.). The ACOE report summarized the findings of a computer modeling analysis of the wave climate in the vicinity of Fire Island

Inlet, which demonstrated that the water level inside the inlet (i.e., including the Oak Beach shoreline) would not be significantly altered by variations in bathymetry at the inlet entrance caused by maintenance dredging of the navigation channel. It was further concluded that the wave energy striking Oak Beach does not increase when the navigation channel is maintained.

Because of the legal action undertaken by residents of Oak Beach, a period of more than a decade elapsed without beach nourishment activities being undertaken along Gilgo Beach. Although that period was characterized by relatively low severity of coastal storms, except for Hurricane Gloria in 1985, the effect at Gilgo Beach was steady shoreline recession (OPRHP and SEMO, 1988) due to the loss of westward-flowing littoral material into the unmaintained inlet. Since the ACOE maintenance dredging program at Fire Island Inlet is scheduled to occur at approximately two-year intervals, it is clear that several maintenance dredging/beach nourishment operations would have been undertaken between 1977 and 1989 in the absence of the lawsuit, in which case, present erosion damage at Gilgo Beach may have been less severe.

4.5 EXISTING EROSION AND FLOOD CONTROL MEASURES

4.5.1 LEGISLATION, REGULATIONS, AND STANDARDS

Development in erosion-prone and flood-sensitive areas is currently regulated by a variety of local, State, and Federal programs and legislation. These include the National Flood Insurance Program (NFIP) administered by the Federal Emergency Management Agency (FEMA) and the local regulations that have been promulgated pursuant to the NFIP, as well as the New York State Coastal Erosion Hazard Areas Act (Article 34 of the New York State Environmental Conservation Law) and Coastal Barrier Resources Act, and accompanying regulations and area maps. These local, State and Federal regulations are discussed individually below.

A. *The National Flood Insurance Program*

The Federal Government adopted the National Flood Insurance Act in 1968 to provide, for the first time, flood insurance protection to owners of structures in flood-prone areas. The low cost insurance coverage that was established by this legislation was made available on a voluntary basis to individuals in those communities that adopted and enforced certain minimum standards for flood protection.

The National Flood Insurance Act was amended in 1973 by the Flood Disaster Protection Act, which required that communities in designated flood prone areas participate in the flood insurance program or face loss of Federal financial assistance. As a condition of receiving any form of financial assistance directly provided from or indirectly backed by Federal funds, property owners in participating communities are required to purchase flood insurance prior to undertaking acquisition or construction on lands within the designated flood zones. Some lending institutions require that loans for properties in the flood plain be protected by flood insurance policies as a matter of corporate policy, independent of FEMA requirements.

One of the first major tasks that was undertaken by FEMA in accordance with their responsibility for administering the NFIP was the development a series of flood insurance rate maps (FIRMs) for all coastal communities. The FIRMS delineate the boundaries of flood plains on the basis of changes in ground elevation, vegetation and natural features, and identify flood elevations based on scientific analyses of previous storm events. This information was used to subdivide the flood plain into specific zones which are characterized by varying degrees of potential flood hazard. For example, the inland boundary of the A zone represents the approximate limit of the 100-year coastal flood. The V1 through V30 zones have significant potential wave velocity impacts, while the A1 through A30 zones have mostly stillwater flooding impacts. The number following the letter designation is a FEMA code that indicates the level of storm damage vulnerability, which is used by insurance providers to set actuarial rates for flood insurance coverage. The base flood elevation, which is the approximate level of the 100-year flood, is also taken into consideration in the computation of flood insurance rates. See Sections 4.2.2.A and 4.3.1 for further discussion of this topic.

In order for residents of a community to be eligible for flood insurance under this program, the local governing body of the community must enact regulations which require that all new or substantially improved structures located in flood hazard areas be built in accordance with minimum Federal floodplain management criteria. The Town of Babylon secured eligibility through the 1988 adoption of Chapter 125 of the Town Code, "Flood Damage Control", which is discussed in the following subsection.

FEMA has instituted the Community Rating System (CRS), which is an incentive program of flood insurance rate credits given to communities that implement mitigation activities beyond minimal NFIP requirements. The Town of Babylon was accepted into the CRS program by virtue of an application that was submitted in 1992 (Castenada, Town of Babylon, May 24, 1994, telephone communication). The continuation of flood insurance credits is contingent upon the Town's submission of a renewal application to FEMA on an annual basis. This is discussed more extensively in Section 4.8.4.

The CRS awards points for specific mitigation activities that are implemented by the Town, with the point values varying according to FEMA's assessment of the mitigative quality of each activity. The Town has already qualified for a 5 percent reduction (which became effective in October 1993) through the implementation of "outreach" projects and the enactment of flooding and erosion control ordinances. The "outreach" projects include the distribution of informational flyers to residents in the floodplain, the establishment of a flood protection library at the local public library (which must include public notification of the availability of these reference materials), and the institution of a system for providing consultation and information to members of the community who request such services. Additionally, the Town's Coastal Erosion and Flood Damage Control Ordinances (Chapters 99 and 125 of the Town Code - see Section 4.5.1.B) were awarded CRS points because these pieces of legislation regulate special hazard areas.

The Town can accumulate additional points in the future by submitting a variety of written programs for FEMA review. For example, it is anticipated that another 5 percent reduction in flood insurance premiums will be realized through FEMA's acceptance and the Town's implementation of a plan for reducing repetitive flood losses. This report was submitted to FEMA in October 1993. The Town's existing flood and hurricane mitigation plan can also be applied toward flood insurance credits; however, that document would need revision to conform with the specific format required by FEMA. Credit can also be gained by formulating an open space plan which specifies that certain portions of the Town's lands on the barrier and bay islands would be forever protected from development (Zitani, Town of Babylon, December 1, 1992, telephone communication).

B. ***Town of Babylon Flood Damage Control Ordinance***

Chapter 125 of the Babylon Town Code establishes specific regulations which govern construction activities in designated flood zones. The approval of any building permit application for a structure to be located in an area of special flood hazard is contingent upon compliance with the provisions of this ordinance, which is administered and enforced by the Chief Building Inspector of the Town of Babylon. Requests for variances from the requirements of Chapter 125 and appeals of decisions rendered by the Town under this program may be presented to the Zoning Board of Appeals (ZBA). The ZBA bases its determination of the disposition of any given appeal or variance request upon the intent and regulatory requirements of Chapter 125, and on an evaluation of twelve specific factors concerning aspects of public safety and health, land use compatibility, potential public expense, feasible alternatives to the proposed action, importance of the proposed facility to the community, the dependency of the proposed facility on a waterfront location, and other parameters. As with all other governmental proceedings, the applicant has recourse to file a court appeal under Article 78 of the Civil Practice of Law and Rules once all administrative avenues of appeal have been exhausted.

Strict standards apply to new construction or substantial improvements to existing structures in designated flood areas, where "substantial improvement" generally includes any project that involves repair, reconstruction, or improvement that either costs 50 percent or more of the replacement cost of the structure, or entails an increase of 25 percent or more in the total square footage of the structure (refer to Chapter 125 of the Babylon Town Code for a precise definition and a discussion of exclusions). The following standards apply to new residential structures and substantial improvements to such construction within the A zone (areas of special flood hazard):

- anchoring shall be used to prevent flotation collapse or lateral movement of the structure
- materials and utility equipment which are resistant to flood damage shall be used
- construction methods and practices that minimize flood damage shall be used
- the lowest floor, including basement or cellar, shall be elevated above the base flood elevation
- fully enclosed areas below the lowest floor shall be designed to automatically equalize hydrostatic flood forces by allowing for the entry and exit of floodwaters

The following standards apply to new residential structures and substantial improvements to such construction within the V zone (coastal high hazard areas):

- all structures shall be located 200 feet landward of the toe of the dune or, in cases where there are no dunes, landward of the reach of high tide
- structures shall be elevated on pilings so that the lowest horizontal member supporting the lowest floor is elevated to or above the base flood elevation
- the pilings and structure attached thereto shall be adequately anchored to prevent floatation
- piles shall meet minimum standards with regard to dimensions, embedment, spacing, bracing, connections to horizontal structural members, method of installation, and other parameters specified in Chapter 125
- structures shall be designed to resist the water and wind forces which occur during the base flood event
- the space below the lowest floor shall be kept free of any obstructions or shall be constructed with breakaway walls, open wood latticework, or insect screening intended to collapse under wind and water loads without causing displacement or other structural damage to the elevated portion of the building or supporting foundation system
- breakaway walls shall meet design standards specified in Chapter 125
- all utility equipment servicing the building (including heating, ventilating, and air conditioning equipment, water heaters, appliances, electrical junction boxes and service panels) shall be elevated to or above the base flood elevation

- all construction shall be certified by a licensed professional engineer or registered architect, attesting that the design and methods of construction to be used are in accordance with accepted standards of practice and all applicable provisions of Chapter 125

C. ***Coastal Erosion Hazard Areas***

In 1981, the New York State Legislature passed the Coastal Erosion Hazard Areas Act (ECL Article 34) as the principal law governing erosion and flood control along the New York State coastline. The purpose of Article 34 is to establish standards and administrative/enforcement requirements that serve to minimize or prevent damage to property and natural resources from flooding and erosion caused by inappropriate human activity in the coastal zone. This legislation is implemented through the issuance of permits for development and other land use activities in designated coastal erosion hazard areas.

Coastal erosion hazard areas are defined as those land and/or water areas which contain natural protective features (such as bluffs, dunes, beaches, nearshore areas, or wetlands) and those areas (designated as structural hazard areas) which are located landward of natural protective features where the shoreline is receding at a long-term rate of one foot or more per year. Lands which are regulated by this legislation are delineated on Coastal Erosion Hazard Area (CEHA) maps which have been prepared by NYSDEC. After these maps were completed, local governments were given the option to adopt a State-approved model coastal erosion ordinance, which incorporates the standards outlined in the State CEHA regulations. For each municipality that chose not to establish such a program on a local level, regulatory authority reverted to the County or State. The Town of Babylon, by means of the adoption of Chapter 99 of the Town Code (Coastal Erosion Hazard Areas), has established local control over the CEHA program. The responsibility and authority for administering and enforcing the requirements of this ordinance has been officially conferred on the Commissioner of the Town of Babylon Department of Environmental Control.

A coastal erosion management permit must be obtained from the Town of Babylon for each action that involves redevelopment, new construction, erosion protection structures, public investment, or other land use activities within the CEHA. Dredging, excavating, and mining are prohibited in the nearshore zone, as well as on beaches and primary dunes located within the designated area. Traffic control provisions of Chapter 99 include: motor vehicle traffic on vegetation is prohibited; motor vehicles must travel seaward of the debris line, or where no debris line exists, seaward of the seaward toe of the primary dune; motor vehicle traffic on the primary dune is prohibited, except at officially posted access points; and pedestrian access across primary dunes must utilize elevated walkways and stairways, or other specially designed dune crossing structures. Activities generally not requiring a coastal erosion management permit include: planting and sand fencing for the purpose of sand entrapment and stabilization of dunes; installation of seasonal floating docks and similar structures; normal beach grooming or cleanup; normal and customary maintenance of existing structures conducted in compliance with an approved maintenance program; and the erection of private elevated stairways by an individual property owner solely for non-commercial, pedestrian access to the beach.

The issuance of a coastal erosion management permit for a proposed action is contingent upon compliance with established standards, restrictions, and requirements for the avoidance or minimization of coastal erosion impacts. The determination of compliance is based on a review of the completed permit application, as conducted by the technical staff of the Town of Babylon Department of Environmental Control. Conditions may be attached to a permit, if deemed necessary for an action to conform with the requirements of Chapter 99 and related standards. In general, a permit will be issued only if a proposed regulated action meets the following general standards (Town of Babylon Code §99-9):

- the proposed action must be reasonable and necessary, considering alternative sites and the necessity for a shoreline location;
- the proposed action must not cause a measurable increase in erosion at the project site or at other locations; and
- the proposed action must prevent or minimize adverse effects to natural protective features, existing erosion protection structures, and natural resources.

In addition to the general standards listed above, any project that involves the construction, modification or restoration of an erosion protection structure must be designed according to generally accepted engineering principles which have demonstrated success or, where sufficient data is not currently available, a likelihood of success in controlling erosion on the immediate site for at least 30 years (Town of Babylon Code §99-13).

Requests for variances from the requirements of Chapter 99 and appeals of decisions rendered by the Town under this program must be presented in writing to the Town Board, which has been designated as the Coastal Erosion Hazard Board of Review. The applicant also has recourse to file a court appeal under Article 78 of the Civil Practice Law and Rules, once all administrative avenues of appeal have been exhausted.

No prohibition on reconstructing substantially storm-damaged houses has been enforced to date in the Babylon CEHA (or in the CEHAs of neighboring towns, for that matter); no storms that have occurred since the adoption of the State's regulations have caused structural damage sufficient to prompt applications for such reconstruction.

Consequently, the legal foundation of this policy has not been tested. However, CEHA laws in neighboring towns (e.g., Islip and Brookhaven) will likely be put to the test in the near future as a result of the severe damage barrier beach residences that was caused by the 11-12 December 1992 northeaster (as noted in Section 4.3.2.E, no houses in Babylon's CEHA were destroyed).

NYSDEC has designated the entire south side of the barrier island in the Town of Babylon as a coastal erosion hazard area. The CEHA boundary follows the southern edge of the eastbound roadway pavement of Ocean Parkway, from the Babylon-Oyster Bay Town line eastward to the vicinity of the Cedar Beach pavilion. For the remaining length of oceanfront shoreline in Babylon Town, the CEHA boundary lies to the south of the parkway. Between Gilgo and Captree State Parks, the coastal erosion hazard area includes portions of the associated and non-associated communities at Oak Beach; generally, the seaward-most row of houses in these communities are situated within the CEHA (see Plates 1E through 1G). The other four communities in the study area (i.e., West Gilgo, Gilgo, and Oak and Captree Islands) lie outside the designated CEHA area, and therefore are not subject to the CEHA regulations.

D. *Coastal Barrier Resources Act*

In October 1982, the Congress passed the Coastal Barrier Resources Act (CBRA). The CBRA prohibits the expenditure of Federal funds for the development of those designated areas within the barrier system that are not presently developed. The CBRA funding prohibition extends to grants, loans, loan guarantees, and flood insurance. The status of the study area with respect to regulatory coverage under the CBRA is depicted on the FIRMs, which indicate that most of the barrier and bay island areas in the Town of Babylon lie within the regulated zone, but which also clearly show that the developed community areas are not situated within the regulated zone. Further verification of the subject communities' exempt status was obtained during a telephone interview on November 2, 1992 with Mr. Frank McGilvery of the U.S. Department of the Interior.

E. *Miscellaneous Regulations*

Other regulations provide indirect protection against flooding and erosion damage. For example, tidal wetlands, in addition to a number of other important functions, serve to control flooding and buffer the effect of storm waves. Therefore, regulations (i.e., 6NYCRR Part 661 - New York State Tidal Wetland Land Use Regulations, promulgated in accordance with Article 25 of the NYS Environmental Conservation Law) that have been enacted primarily to protect the ecological resources of wetland areas from human disturbance will also act to preserve the flood control benefits of these features.

4.5.2 EROSION AND FLOOD CONTROL STRUCTURES IN THE STUDY AREA

CA's field investigations included a survey of shoreline protection devices that have been constructed within the study area. This work revealed that the shoreline in the subject communities is characterized by four general categories of structural protection: natural shoreline (i.e., no protective structures), bulkheads, revetments, and groins. Of the approximately 24,000-foot total length of shoreline in the six communities, only about 8,000 feet has not been equipped with some type of protective structure (see Table 4-1; particularly the notes, which define the shoreline length that was measured in each community).

Bulkheads are wall-like structures, usually composed of timber, that are built along the shoreline and are intended to retain upland material. Revetments are also built along the shoreline, but are composed of rock or concrete rubble which is intended to provide "armoring" for protection against wave attack. Groins, which can be composed of either timber or rock/concrete rubble, are installed perpendicular to the shoreline for the purpose of trapping sediment moving nearshore in the littoral drift.

A. *Bulkheads*

The distribution of protective structures along the shoreline in the subject communities is depicted in Plates 1A through 1G. Bulkheads are the most common form of structural protection in the study area, and are present in all six communities. Bulkheads have been installed along approximately 52 percent of the total length of shoreline in the subject communities (see Table 4-1). All of this length of bulkheading has been privately built, and is generally maintained by individual homeowners.

The bulkheads in the study area generally appear to be well-maintained. Based on a qualitative visual inspection conducted by CA as part of this study, only about 10 percent of the length of these structures within the subject communities appeared to be in need of near-future maintenance. However, it is important to note that this assessment was based on the condition of the visible portions of the bulkheads (i.e., the facing and top beam), which may not accurately reflect the condition of important internal structural components (e.g., tie rods and anchors). The length of deteriorated bulkhead in the Captree Island community and West Gilgo Beach marina was proportionately higher than in the study area as a whole (Table 4-1).

The bulkheading in the subject communities has generally been adequate in retaining fill material. However, some loss of fill was noted, especially on Oak and Captree Islands and at Oak Beach (Table 4-1). In some areas, the loss of fill has occurred as the result of seepage through gaps in the face of deteriorated segments of bulkhead. Some loss of fill appears to have occurred through the gaps between the facing boards along stretches of good condition bulkhead. At other locations, the lack of fill behind the bulkhead may be due more to the original conditions of installation than to the actual loss of material; tidal waters were found to circulate behind relatively new sections of bulkhead at several sites on Oak and Captree Islands.

The rate of erosion is often intensified along segments of natural shoreline that are interspersed among shore-parallel protective structures (i.e., bulkheads and revetments). The occurrence of this type of localized erosion, which was observed at scattered locations on Captree Island and in the Oak Beach communities, is caused by the refraction and reflection of wave energy due to the adjacent structures.

B. ***Revetments and Groins***

The longest segments of shoreline protected by revetments and groins in the vicinity of the study area are found along the ±2,500-foot long section of Oak Beach Avenue between the western and eastern portions of the unassociated Oak Beach community. However, only about 13 percent of the total length of shoreline within the communities contains these structures, which are found only in the Oak Beach Association, Oak Beach, and Captree Island.

Most of the groins in the study area are composed of concrete rubble, some of which contains steel reinforcement bars. Bricks, cinder blocks, piping, and similar materials were also found in these structures. A number of the rubble groins in the study area and vicinity have been topped with dirt fill, which in many cases has been planted or become naturally seeded with a variety of vegetation (see Section 5.1.5).

Wooden groins also exist in some portions of the study area, especially beneath the fixed docks that are present at the eastern end of Oak Beach and at several locations within the Oak Beach Association. In general, these groins are in good condition. Examination of the aerial photographs reveals that the wooden groins in the study area have been somewhat successful in trapping sand moving in the long-shore drift (see Plates 1E through 1G).

Coch and Wolff (1991) found that the presence of groins caused some houses to be preferentially washed out during the passage of Hurricane Hugo in coastal South Carolina. This localized damage resulted when water was impounded on the upwind side of the groins, increasing the surge height at those locations.

C. ***Miscellaneous Structures***

Snow (sand) fencing has been installed at numerous locations within the Oak Beach communities (see Plates 1E through 1G) in an effort to augment the amount of sand contained within the dunes. This effort has met with varied success. In some areas, the snow fencing is intact and significant volumes of sand have accumulated. In other areas, the snow fencing has not been maintained and has been ineffectual in trapping sand. Recent dune grass plantings have also been used as a means of providing enhanced sand trapping capabilities at scattered locations within the Oak Beach communities (see Section 5.1.4).

Plywood sheeting has been installed on the inland side of the boardwalk along certain segments of the southerly shore of Oak Island. The intended purpose of these makeshift walls is apparently to provide some protection against wave erosion to a series of houses that are located at very low elevation and in very close proximity to the water. However, although these devices may provide some degree of abatement against the daily action of the tide and the small waves that are typically found in that area, they are not likely to withstand intense storm conditions. Furthermore, it is possible that the presence of this plywood sheeting on the boardwalk could increase the chances that the affected section of the boardwalk will fail in a storm, particularly if a strong ebb surge pushes against the boardwalk from the north. In fact, this boardwalk was severely damaged during the 11-12 December 1992 northeaster (see Section 4.3.2.E).

Residents at certain locations in the Oak Beach communities have deposited debris (such as dead trees and shrubs) on the seaward dune face in front of their homes. This measure is intended to provide sand trapping capability, similar to the Town's program for the placement of Christmas trees along the oceanfront dunes. Unfortunately, in many cases, storm waves attack these debris piles before a sufficient quantity of sand can accumulate, and the trees and shrubs and associated materials are converted to flotsam. Additionally, the efficacy of such measures is questionable because these areas lack an adequate sandy beach to serve as a source of wind-blown sand.

4.5.3 NON-STRUCTURAL EROSION AND FLOOD CONTROL MEASURES USED IN THE STUDY AREA

A. *Beach Nourishment*

The deposition along Jones Island of spoil material generated by the dredging operation conducted at Fire Island Inlet provides a significant degree of storm protection to the subject residential communities. As discussed in Section 4.4.1, the section of Jones Island in the Town of Babylon has been subject to chronic erosion since shortly after the jetty was installed at Democrat Point in 1941. Beach nourishment activities undertaken in conjunction with the dredging project substantially widen the buffer area in front of the dunes (at least on a temporary basis), which absorbs a large portion of the wave energy that impinges upon the shoreline, and diminishes the potential for storm waves to erode the dunes and damage public infrastructure located to the north.

The dredging of Fire Island Inlet is performed under the supervision of the U.S. Army Corps of Engineers (ACOE), which is governed by policy guidelines which require that dredge spoil be disposed of in a "least cost" manner. In general, open water disposal is least costly option, which would preclude the ACOE from utilizing dredged material for beach nourishment purposes. However, if it is determined that beach nourishment is in the public interest, and if state and local governments are willing to expend funds to cover the additional costs that are incurred to dispose the spoil on the beach, the ACOE is amenable to allowing the dredging contract to include beach nourishment activities.

In 1973, the ACOE and the State of New York entered into a Local Cooperation Agreement regarding the Federal navigation project at Fire Island Inlet. This agreement specifies that the ACOE will use the sand dredged from the inlet to nourish the shoreline along Jones Island, with 82.6 percent of the total project cost to be drawn from Federal funds and 17.6 percent of these costs coming from State funds. The actual cost of the beach nourishment component of the project exceeds the State funding contribution (Daley, NYSDEC, December 17, 1992, telephone communication), so the terms of the agreement are favorable to New York State.

The ongoing dredging operation at Fire Island Inlet represents the final phase of a New York State funding appropriation that lasted through three phases. Reauthorization is pending before the NYS Legislature for an additional three phases of dredging, which, if approved, would be expected to cover the State's financial obligations to the project for five to six more years.

New York State has generally not had a problem meeting its financial commitments in this type of cost sharing project. There can be some delay in allocating State funds - due to the nonconcurrent fiscal years and the difference in procurement mechanisms of the State and Federal governments. However, to date the Fire Island Inlet dredging/beach nourishment project has not been delayed due to fiscal problems.

B. *Dune Reconstruction*

In addition to the erosion mitigation that is provided on a semi-regular basis through the Fire Island Inlet dredging project, an intricate governmental mechanism has been established to address immediate erosion crises along the Jones Island oceanfront. This response mechanism is described in the "Coastal Erosion Response Plan for the Jones Beach Barrier Island", which was prepared by a task force that was headed by the New York State Office of Parks, Recreation and Historic Preservation and the State Emergency Management Office (OPRHP and SEMO, 1988). The key elements of this plan, which serves as the site-specific component of the State-wide emergency management plan, are described below.

The main objectives of the Jones Beach Coastal Erosion Response Plan are to forestall the formation of new inlets through Jones Island and to take necessary measures to maintain the integrity of the character of Jones Island (including its transportation network, its natural features, and its public and private facilities). The construction of several hundred feet of earthen embankment ("artificial dunes") was undertaken at two locations at Gilgo Beach in the fall of 1987. This emergency response action, which also entailed the rerouting of all Ocean Parkway traffic onto the westbound lanes, was implemented under an early version of the OPRHP/SEMO plan.

In order to achieve the above stated objectives, the following basic elements have been incorporated into the OPRHP/SEMO plan:

- on-going site monitoring;
- review of factors that have contributed to accelerated erosion;
- the development of action plans by the SEMO and the OPRHP for responding to various categories of storm-generated erosion events;
- the assignment of specific roles for the below-listed participating agencies, including a chain of command;
- the development of a computerized data base to facilitate the identification of trends; and
- the stockpiling of materials necessary to respond to an erosion emergency.

A wide variety of agencies have jurisdiction or technical interest in the erosion problem on Jones Island. A full delineation of agency roles is beyond the scope of this study. However, some of the primary players and their main avenue of involvement are as follows: the NYS Department of Transportation (NYSDOT) is responsible for maintaining Ocean Parkway; the OPRHP oversees activities in the State's parklands and, along with NYSDOT, acts as the lead agency for most erosion mitigation projects on Jones Island; the ACOE is responsible for performing the dredging of Fire Island Inlet, which provides material for beach nourishment activities, and also has primary responsibility (with NYSDEC, NYSDOT, and OPRHP) for damage assessment following a storm; the SEMO coordinates interaction among the involved agencies and, along with the National Atmospheric and Oceanic Administration, is responsible for monitoring and reporting significant weather trends; the Town of Babylon is, in part, responsible for public notification and evacuation during an impending storm; the state and county police are responsible for maintaining law and order during a disaster; and NYSDEC provides support for various technical activities. A variety of agencies contribute to the monitoring of site conditions and the processing of data collected during field observations.

The OPRHP/SEMO plan establishes three levels of coastal erosion emergencies for Jones Island. The critical threshold for action under all three levels, called the "actionable threshold", occurs when the eroded embankment along the south side of Ocean Parkway has approached to within 20 feet of the edge of the pavement, or when the observed rate of erosion indicates a high probability that this criterion will be met. A "Type A" event is defined as one in which erosion has occurred to or near the actionable threshold, and the tide is falling, and the storm is abating and/or the direction of the wind is changing. A "Type B" event is defined as one in which erosion has occurred to or near the actionable threshold, and the storm intensity is severe, and it is likely that the storm will endure through at least the next tidal cycle, and the winds are steady or increasing in intensity, and the rate and scale of erosion are high. A "Type C" event is defined as one in which erosion has occurred to or beyond the actionable threshold, and storm intensity is high, and the rate and scale of erosion are high, and the storm is predicted to endure through several tidal cycles, and the winds are steady or increasing in intensity, and a breach across Jones Island is imminent and is expected to enlarge quickly. It is estimated that the cost (in 1988 dollars) of required remediation will be approximately $20,000 per Type A event, $40,000 per Type B event, and between $850,000 and $1,200,000 for a Type C event.

It is important to note that the protection of the Outer Beach residences is <u>not</u> a primary consideration in the beach nourishment and erosion emergency measures that are described above. The overriding concerns of the involved agencies are the protection of Ocean Parkway, which is a major east-west transportation route, and the prevention of a breach through the barrier, which could have far-reaching adverse environmental impacts throughout Great South Bay (Cashin Associates, P.C., September 1993). Thus, erosion response planning would be just as vital for the study area, even if residences were not located on the barrier and bay islands. On the other hand, it is equally important to recognize that the relatively high degree of storm damage protection afforded to the communities on the back barrier (i.e., West Gilgo and Gilgo Beach) is largely dependent on the mitigation benefits derived from the indefinite continuation of the beach nourishment and erosion emergency projects on Jones Island.

C. *Miscellaneous Measures*

CA's field survey revealed that dune grass plantings have been used at scattered waterfront locations throughout the Oak Beach communities in an effort to provide stabilization to the sandy sediments along the shoreline. However, since this area generally lacks a substantial width of beach (except at Oak Beach West), insufficient sand is available to allow the natural process of dune accretion to operate to any significant degree.

Residents at the eastern end of the Captree Island community have indicated to CA that boating traffic through the State Boat Channel has caused a significant amount of erosion to the shoreline on both sides of the channel just west of the draw bridge to Robert Moses State Park. Review of historic aerial photographs support the claim of substantial shoreline recession in the area; shallow coves presently exist where the shoreline had been relatively straight in the past. Although this portion of the State Boat Channel is posted with a speed limit of 5 mph (in accordance with Section 86-6 of the Town of Babylon Code) to eliminate boat wake, residents claim that these signs are generally not obeyed. Some Captree Island residents have expressed particular concern with the party fishing vessels originating in Captree boat basin, which, according to those residents, trail large wakes and tend to pass by in rapid succession.

4.6 MECHANISMS OF FLOOD DAMAGE RELIEF

4.6.1 NATIONAL FLOOD INSURANCE PROGRAM

The primary mechanism that has been established to provide monetary assistance to victims of a flood disaster is the National Flood Insurance Program (NFIP). As discussed in Section 4.5.1.A, the NFIP makes flood insurance available to all homeowners in the subject communities, and requires that flood insurance be purchased prior to any real estate purchase or construction on the Outer Beach that is funded by a Federally secured loan.

During its initial period of implementation, the NFIP was subsidized by the Federal Government. However, since 1986 the amount of revenues collected through NFIP premiums have exceeded the amount issued in payments on claims. Evidence of the actuarial soundness of the NFIP is presented in the Report to Stakeholders for fiscal year 1991 prepared by the Federal Insurance Agency, which is the branch of FEMA that manages the NFIP. The Stakeholders Report states that for the period between October 1, 1990 and September 30, 1991, total revenue for the flood fund were $644 million and total expenses were $480 million, while $219 billion of insurance was in force on 2.5 million policies.

4.6.2 SMALL BUSINESS ADMINISTRATION DISASTER RELIEF PROGRAM

The U.S. Small Business Administration (SBA) oversees a program that provides monetary assistance to flood disaster victims who are not covered by insurance. This assistance takes the form of low interest loans, which are made available to property owners in communities that are situated within a disaster area declared by the President or the SBA. The SBA bases its disaster declarations on specific criteria with respect to the number of structures damaged and the extent of damage to each structure; the President has more discretion in deciding whether a disaster declaration is warranted (Uybarreta, SBA, December 3, 1992, telephone communication).

Since December 1981, four costal storms have resulted in residential disaster declarations in Suffolk County: March 28, 1984; September 27, 1985 (Hurricane Gloria); October 30-31, 1991 (the Halloween northeaster); and December 11-12, 1992. Information is currently available only for the 1991 northeaster with regard to the amount of money loaned to residents in the Town of Babylon; data for the earlier events were not categorized by town, and records have not yet been compiled for the 1992 storm. Town of Babylon residents, including those residing on the mainland, received nine SBA loans totaling $149,500 to cover losses sustained during the Halloween 1991 storm. It is not known if any of these loans were issued to residents of the Outer Beach (Thom, SBA, December 20, 1992, written communication).

Once a disaster has been declared, property owners within the affected communities are notified, through the normal media channels, of the availability of SBA loans. The SBA usually establishes a temporary office within the disaster area to process loan applications. These loans have two levels of interest rates. The lower rate (fixed at 4 percent) applies to most residential loans issued by the SBA. The higher rate is a maximum of 8 percent, but can be lower depending on the prevailing trends in market interest rates (presently this rate is 6.5 percent). The determination as to which rate is applied to each applicant is based upon the financial data provided with the application. Homeowners are eligible for SBA loans only for primary residences; summer/vacation homes do not qualify under this program. The maximum amount available for each homeowner is $100,000 for structural repairs/replacement and $20,000 for personal property. An additional loan of up to $100,000 is available for mortgage refinancing; however, the following restrictions apply: the existing mortgage on the house must have been filed and recorded; the uninsured loss must exceed 40 percent of the pre-disaster market values of the house; the applicant cannot be eligible for credit elsewhere; and the applicant must commit to repairing or replacing the damaged structure (Thom, SBA, December 3, 1992, telephone communication).

The SBA loans granted for disaster relief through this program are below-market-rate. Consequently, the Federal Government is required to subsidize the difference between the program rate and the prevailing rate by means of taxpayer dollars.

As noted in Section 4.3.3.C, homeowners who have not experienced a major flood disaster for an extended period of time, including residents of the subject communities, are prone to underestimate the risk of severe storms. Under these circumstances, homeowners are often inclined to believe that there is not sufficient incentive for them to purchase insurance for protection against an eventuality which they perceive as being extremely remote. Furthermore, the availability of low-interest loans to flood disaster victims through the SBA program can create a sense among homeowners in areas of infrequent storm damage that flood insurance is not really necessary (Davis, SEMO, November 20, 1992, telephone communication). However, as discussed below, there are important shortcomings to foregoing flood insurance under the assumption that comparable financial relief will be made available through the SBA program.

The SBA disaster relief program is provided as a safety net to prevent large-scale disruption of the financial well-being of a community caused by a major natural disaster; this program is not intended to represent an alternative to flood insurance. Consequently, the following important distinctions exist between the protection afforded under the SBA program versus the NFIP:

- SBA loans are made available ***only*** when a disaster has been declared. As opposed to flood insurance, the SBA program does not provide any assistance for storm damages incurred during events that are not officially declared disasters.

- Applications submitted to the SBA disaster relief program are subjected to a full credit and income analysis. Loans are provided only to those individuals who have a documented ability to complete repayment.

- The annual premium for a flood insurance policy (based on the total revenue and number of policies in force during fiscal year 1991, from the FIA Report to Stakeholders for Fiscal Year 1991) is approximately $300 on a national basis. The average flood insurance premium in the Town of Babylon is $403, based on August 31, 1993 NFIP data. Payments on loans secured through the SBA would be several thousand dollars per year for the maximum loan amount of $100,000, even at 4 percent annual interest for a term of 30 years.

- As noted above, SBA loans are not available for summer/vacation residences, which excludes essentially all of the 54 houses on Oak Island, as well as approximately 47 percent of the houses in the other five communities within the study area.

4.7 SEA LEVEL RISE

Although sea level rise was included in the Advisory Committee's initial discussion of issues of concern for the Town of Babylon barrier and bay islands, this topic was omitted from the final scope of work for the environmental study. However, given that coastal erosion is one of the primary study elements, and in light of the widespread view that sea level rise has an important impact on the occurrence of shoreline erosion, it was determined that the purposes of this study would not be fully served by ignoring this issue. Thus, the following discussion is presented to address sea level rise in the context of the Barrier and Bay Island Study.

There is general agreement among the members of the scientific community that sea level has been rising at a gradual, though unsteady rate over the past 100 years. However, there has been some debate with respect to the average historical rate of sea level rise on the south shore of Long Island, depending on the methodology and the location of sea level measurements. Long-term tide gauge records in both New York Harbor and New London, Connecticut indicate an average 0.01-foot per year rate of sea level rise over the past century, but this rate may not be directly applicable to Long Island's ocean shorefront (Tanski and Bokuniewicz, June 1989). Since Long Island is composed of unconsolidated sediments, it is likely that sea level rise here may be somewhat higher due to compaction and subsidence, compared to measurements taken from tide gauges situated on the bedrock of New York Harbor and New London (LIRPB, 1991). A tide gauge that has been installed at Montauk Point has not accumulated a sufficient continuous record to resolve questions about trends in sea level.

If the historical record of sea level rise is inconclusive, there is even more uncertainty concerning the rate at which sea level will rise in the future. Global warming (i.e., the "greenhouse effect") is cited by most theorists as the primary driving force behind rising ocean level. However, since no consensus exists with respect to the rate at which climatic temperature will increase in the future (and, in fact, some scientists believe that the recent rise in global temperature reflects normal short-term variation rather than a long-term trend), it is not possible to state definitively how sea level will respond in the future.

Rising sea level has often been cited as an important factor in the widespread erosion that has occurred on Long Island's shoreline. This conclusion is based on the logical theory that natural shoreline features (i.e., beaches, dunes, bluffs, etc.) will retreat landward in response to a rise in sea level. Certainly over the very long-term past (i.e., in the thousands of years since the end of the last ice age, or even over the course of hundreds of years), sea level rise has been the predominant diving force in the landward migration of the shoreline, a conclusion which has been adequately substantiated by the existing scientific evidence. However, according to research that has been summarized in the Proceedings of a Workshop titled "An Overview and Assessment of the Coastal Processes Data Base for the South Shore of Long Island" (Tanski and Bokuniewicz, June 1989), sea level rise has <u>not</u> played a significant role in the short-term recent erosion that has occurred on Long Island's barrier system. Computer modeling of the adjustment in the shoreline profile that would result solely from a 0.01-foot per year sea level rise indicates that the shoreline of Jones Island would retreat approximately 0.1 foot per year over a ten year period. This component of erosion due solely to sea level rise compares to an overall erosion rate that has been estimated to be as high as 20 to 95 feet along some stretches of Gilgo Beach for the period between 1985 and 1987 (OPRHP and SEMO, 1988). Thus, it was concluded from this analysis that sea level rise is of secondary importance in comparison to other factors (e.g., the interruption of the littoral drift system by Fire Island Inlet and jetty to the updrift side of Jones Beach, the erosive force of major storms, etc.), especially in the context of a planning time frame of 50 years.

The evidence presented above indicates that sea level rise, when considered alone, apparently will not be a major factor in the extent of erosion that will occur along the ocean shorefront on Jones Island during the current term of the residential leases for the subject communities (which have a 2050 expiration date). However, when considered over the longer term, sea level rise, should it occur, would assume a greater degree of importance, especially in combination with other factors. Sea level rise would likely have significant long-term impacts on back barrier areas, such as Oak and Captree Islands, which are relatively secure from the effects of storm waves but are susceptible to still water coastal flooding. Thus, the long-term continuation of sea level rise in the vicinity of the mainland and the study area should continue to be closely monitored. Scientific conclusions should be updated as additional data are collected in the future, and the planning implications of this new information should be evaluated during the course of the current lease term so that appropriate management strategies can be adopted.

The Long Island Regional Planning Board (1989) cited a National Research Council (1987) study of the engineering implications of sea level rise, which examined three possible sea level rise scenarios to the year 2100: rises of 0.5 m, 1.0 m and 1.5 m. According to most projections, the increase in the rate of sea level rise, if it occurs, will not occur in a linear fashion. Rather, the change will start slowly and increase more rapidly in the distant future. Based on the National Research Council projections, accelerated sea level rise could increase present water level elevations along the south shore 4 to 5 cm (0.13 to 0.17 feet) by the year 2000 compared to an increase of 2.5 cm (0.08 feet) if the present rate of sea level rise continues. By the year 2025 the increase due to atmospheric warming could be 13 to 24 cm (0.4 to 0.8 feet), while the expected increase if present conditions persist would be about 8 cm (0.25 feet). For 2050, an accelerated sea level rise could result in water elevations 41 to 50 cm (1.3 to 1.8 feet) higher than present compared to an increase of 26 cm (0.5 feet) under current conditions. While the rate of sea level rise may increase more rapidly beyond 2050, these projections, already subject to a great deal of uncertainty, become less reliable with time. Because of these uncertainties, a rigorous assessment of the management implications of future sea level rise is required.

The gradual rise in sea level may, to varying degrees, result in the following (LIRPB, 1984):

- mobilization of new sediment in the littoral system (this additional sediment may be lost to offshore areas.)
- gradual inundation of coastal structures (e.g., bulkheads, revetments, docks)
- extension of flood zone areas inland - this is especially a problem along much of the mainland and on the bay islands, which are at very

low elevation and gradient; the barrier islands have a steeper gradient and would, therefore, be less susceptible to flood inundation

- displacement of coastal habitats (e.g. wetlands)
- intrusion of salt water into aquifers and increased salinity in tributaries
- interference with gravity flow systems (e.g., storm water drainage)

The design specifications of engineered shoreline structures typically do not take into account the implications of sea level rise.

4.8 FLOOD DAMAGE MITIGATION ALTERNATIVES

4.8.1 PUBLIC PREPAREDNESS AND EVACUATION PLANNING FOR SEVERE STORMS

On the basis of the findings discussed in Section 4.3, it is apparent that the study area (as well as the coastal zone on the mainland) is susceptible to potentially large-scale storm damage and loss of life. An enhanced public education program is needed in order to ensure that the residents of the subject communities respond appropriately to hurricane preparation and evacuation directives. It is essential that this education be given on a continuing basis (e.g., with annual refresher information provided at the commencement of each hurricane season); even a short lapse would diminish the effectiveness of the program. Most importantly, the very real threat that hurricanes pose to the Babylon barrier beach must be properly communicated to all affected residents.

In order to dispel potential attitudes based on personal experience that tend to minimize the potential for damage, it is necessary to provide graphic illustration of the level of destruction that is possible. Perhaps the best means of achieving this objective would be through a pamphlet (to be distributed directly to Outer Beach residents and other Town residents in flood-prone areas, including those along the mainland shoreline) that contains data and photographs of the damage that occurred to the Babylon barrier island as a result of the 1938 hurricane. It would also be valuable for the pamphlet to describe the reasons why Hurricane Gloria did not deliver the anticipated blow to Long Island (i.e., landfall occurred at approximately the time of low astronomical tide and the storm unexpectedly lost strength as it approached Long Island). The pamphlet should also describe actions that should be taken in the event of a major storm, similar to the information that is contained in the current Town of Babylon Hurricane Awareness Brochure.

The media play an important role in any hurricane preparedness plan. Since most of the information the public receives concerning an approaching storm is transmitted by means of radio and television, it is important that this information be relayed accurately and dispassionately. A group of meteorologists from the local media who engaged in a panel discussion at the Hofstra Hurricane Conference on

November 6, 1992 indicated that the best means of accomplishing this objective is more or less to simply relay information that is issued by the National Hurricane Center, providing explanations necessary to ensure that the public understands the facts. These panelists concurred that any interjection of subjective information would not be appropriate and could lead to adverse consequences. For example, conversations with some residents of the study area revealed that certain media reports issued during the approach of Tropical Storm Danielle in late September 1992 contained exaggerations of the extent of flooding that was occurring and misstated the areas that were being flooded. These individuals indicated that the disparity between the actual conditions, which Outer Beach residents could observe directly, and the media accounts may make them more skeptical of storm warnings in the future. To help minimize the potential for this type of problem, the Town should ensure that the media are familiar with the reliable sources of information for local coastal conditions. Further, the Town should maintain an active relationship with the media in order to ensure the accuracy of the information that is being prepared for transmission to the public.

4.8.2 FLOOD ZONE BUILDING STANDARDS

Investigations of the damage that was sustained by coastal communities in South Carolina due to the passage of Hurricane Hugo in September 1989 indicate that houses which were constructed in accordance with FEMA standards had a much lower rate of destruction than slab-on-grade, pre-FEMA houses (Coch and Wolff, 1990 and 1991). In particular, houses on adequate pilings, even those with a waterfront location, were relatively successful in resisting the impact of storm surge. In light of these findings, it is recommended that the Town do whatever is possible to encourage homeowners to bring their homes up to FEMA standards, especially during the earlier years of the current lease term (this effort should also be applied to vulnerable homes on the mainland). Possible avenues of providing monetary incentives for homeowners to engage in this type of activity should be investigated (see Section 4.8.4 concerning the Town's participation in the Community Rating System). Additionally, an effort should be made to ensure that there is no undue hindrance to the processing of building permit applications that will result in the construction of FEMA-compliant houses in place of existing sub-standard houses, especially within the V-zone. In this regard, the environmental review process should be streamlined to the maximum extent practicable, so as to avoid unnecessary delays without sacrificing the "hard look" required under the State Environmental Quality Review Act (SEQRA). Generally, the preparation of an environmental impact statement (EIS) for such a project, which extended over two years from scoping to the acceptance of the final EIS in the case of the application for a building permit at 19 Cottage Walk in Gilgo Beach (Ingham, et.al., October 1989 and August 1990), would not be necessary in the absence of special environmental concerns.

Another finding of the Coch and Wolff (1990 and 1991) post-Hugo studies of South Carolina was that peripheral structures (e.g., gazebos, patio decks, and stairways) became floating debris that produced serious damage to other structures. Presently the Town of Babylon Building Code does specify standards for storm damage resistance of peripheral structures in the coastal high hazard area (V zone). In order to reduce the potential for impact damage to be caused by waterborne debris, therefore, it is recommended that the Town's Building Code be amended to provide suitable standards for the storm damage resistance of peripheral structures that are installed in the V zone. Additional measures should be implemented, as appropriate, to minimize the amount of debris that becomes waterborne during a major storm.

Preliminary reports have indicated that improperly secured propane tanks created a potentially significant problem within the subject communities during the 11-12 December 1992 northeaster. The possibility for an explosion arising from this situation warrants more stringent implementation of existing fire protection standards (e.g.: Standard 58 of the National Fire Protection Association, and Part 1001 of the New York State Fire Prevention and Building Code), which require propane tanks to be securely fastened to adjacent structures.

4.8.3 PARTICIPATION IN THE NATIONAL FLOOD INSURANCE PROGRAM

Preliminary information indicated that the rate of participation in the NFIP is generally low for most Long Island communities, including the study area. However, the results of the homeowner survey reveal that flood insurance coverage is actually much higher on the Outer Beach than was expected (see Appendix A). The participation rate is still much less than 100 percent, which indicates that the occurrence of a major coastal storm could have devastating financial impacts on the subject communities by forcing uninsured residents to seek other available avenues of monetary relief, such as the SBA loan program, which involves several important restrictive conditions (see Section 4.6.2).

In order to ensure that Outer Beach residents who have opted out of flood insurance coverage under the NFIP have done so on the basis of an informed decision, it is recommended that the Town distribute pertinent educational materials to the affected residents. These materials should explain the objectives of the NFIP, and should highlight the advantages of having flood insurance versus other possible means of disaster relief. FEMA should be able to provide assistance in creating an effective informational packet for the subject communities.

4.8.4 PARTICIPATION IN THE COMMUNITY RATING SYSTEM

As discussed in Section 4.5.1.A, the Town of Babylon was accepted on a probationary basis into the Community Rating System (CRS) component of FEMA's National Flood Insurance Program (NFIP). To date, the Town has implemented programs that have been reflected in a 5 percent reduction in flood insurance policy rates Town-wide. Work in progress is expected to result in another 5 percent flood insurance rate reduction (Castenada, Town of Babylon, May 24, 1994, telephone communication).

The Town's CRS probationary status has expired due to a compliance problem resulting from a difference in interpretation of the FEMA regulations. It is expected that the Town will reapply for acceptance into the CRS program in October of 1994. The Town Board, however, is currently evaluating whether the savings benefits to policyholders derived from this program are worth the costs incurred by the Town (i.e., Town taxpayers) in manpower expended to assemble and submit CRS application materials. Reapplication in October of 1994 and future participation in the program will be contingent upon the Town Board's determination.

In the event that the Town's participation in the CRS program is renewed, additional mitigative alternatives that are considered to be feasible for Town implementation in the next two to three years could increase the total savings in flood insurance rates to 25 percent for Town residents. These measures would consist mostly of adapting existing Town of Babylon programs to the strict format specified by FEMA. The accumulation of points above the level needed for a 25 percent credit would generally require the initiation of new programs, including: major capital improvements, such as structural projects, which apply mostly to freshwater drainage; the removal of existing structures from flood-prone areas; the enactment of restrictive new legislation; and the initiation of a financial incentive program for upgrading houses on the Outer Beach (as well as on the mainland) that presently do not conform with FEMA requirements for flood damage resistance (Zitani, Town of Babylon, December 1, 1992, telephone communication).

The CRS measures that would be targeted for implementation in the next several years could benefit the residents of the subject communities in two ways: through further savings in flood insurance premiums, and through a reduction in the susceptibility of the study area to flood damage. The benefit derived from the insurance credits is straightforward; as points would be awarded for mitigation activities submitted by the Town for FEMA review, Town residents would automatically receive reduced flood insurance premiums. It is less readily apparent that these actions will mitigate potential flood damage, since the Town's short-term CRS goals primarily involve amending existing Town programs. However, the Town will ensure optimal effectiveness of these programs by attaining conformance with the strict standards prescribed by the flood damage control experts at FEMA.

The continuation of CRS flood insurance credits requires that the Town submit a renewal application to FEMA on an annual basis. Furthermore, an ongoing, repetitive effort is needed in order for certain of the measures under this program (especially the "outreach" activities) to be effective. Thus, it is essential that the Town maintain a commitment to sustaining its participation in the CRS program. This will ultimately be decided by the Town Board. Additionally, the Town should continue to investigate options for expanding its level of participation. For example, the availability of sources of revenue to fund the conversion of existing houses to meet FEMA requirements should be pursued.

4.9 EROSION MITIGATION ALTERNATIVES

Although discussed as separate topics for the sake of clarity, mitigation measures for flood damage and erosion are closely related to one another. In particular, the primary erosion mitigation measures for the subject communities, which are discussed in Sections 4.9.1 through 4.9.3, also serve as the principle measures by which the study area has been protected from severe storm damage. The cessation of artificial measures to maintain the protective capacity of certain highly dynamic geologic features (i.e., the beach and dunes at Gilgo and West Gilgo Beaches, the Sore Thumb, and the shoal to the west of Democrat Point) would clearly expose the respective barrier island communities to a greater degree of potential storm hazard.

It appears unlikely that actions to protect the West Gilgo and Gilgo Beach shorelines would be abandoned in the foreseeable future, due to the overriding concerns with the structural integrity of Ocean Parkway and the undesirable consequences of the formation of a new inlet. However, despite the high priority assigned to shoreline restoration in this area, the implementation of these measures provides no long-term guarantee of their effectiveness. As noted previously, the shoreline at Gilgo and West Gilgo Beaches is highly vulnerable at the present time due to the loss of beach and dune material during the 11-12 December 1992 northeaster. Thus, even though the residences at West Gilgo and Gilgo Beaches will likely enjoy the indefinite continuation of the partial mitigation provided by the on-going beach nourishment and dune reconstruction projects, these communities have become increasingly vulnerable to storm damage. A severe storm occurring during a period of deteriorated beach and dune conditions, as currently exist, would have a higher probability of causing storm wave impacts on the back barrier than at any time in the past.

The residences at Oak Beach are probably even more vulnerable to future storm damage than the communities on Jones Island to the west. Although the Sore Thumb has been successful in abating the erosion problem that had occurred along Oak Beach prior to 1959, subsequent storms have gradually removed material from this man-made feature, increasing its vulnerability to a total breach. As discussed in Section 4.4.1.B, the long-term maintenance prospects for this structure are at best uncertain.

The maintenance of navigation depth in the channels of Fire Island Inlet and Great South Bay requires periodic dredging. Since Section 404 permits (Ocean Disposal of Dredged Material) are increasingly difficult to obtain, upland disposal should be the prime alternative. This is consistent with the policy of the U.S. Army Corps of Engineers. The sand dredged from adjacent channels should be disposed of on Town-owned lands, which will accrue the following benefits:

- Town-owned beachfront will be expanded, increasing the recreational potential of these lands;
- the additional sand will provide Town-owned lands with protection from severe storms and coastal erosion;
- disposal costs would be lower than for offshore disposal due to decreased transport distances; and
- offshore disposal would be avoided at a time when regulations are increasing directed against this option.

4.9.1 BEACH NOURISHMENT

The erosion problem that exists along the south shore of Jones Island has been caused primarily by the interruption of the incoming supply of littoral sand due to the stabilization of Fire Island Inlet and the construction of the associated jetty, combined with the occurrence of a series of closely spaced major storms. The most preferred approach to mitigating this problem is periodic beach nourishment using sand bypassed from Fire Island Inlet. This recommendation was advanced as the single most important erosion management strategy for the south shore of Jones Island during a workshop sponsored by the NYS Department of State (Tanski and Bokuniewicz, August 1989), and has been supported by the Long Island Regional Planning Board (December 1991 and December 1989).

It is clear that the viability of the barrier beach in the study area requires that the eroding section of Gilgo Beach be renourished on a regular basis. The extent of shoreline recession has reached a critical point, whereby natural geologic processes are not presently adequate to maintain the beach. Sand bypassing is needed to combat the increasingly probable occurrence of a breach. A recurrence of the extended hiatus in the dredging/beach nourishment project, similar to the lull in activity that was caused by the Oak Beach litigation (see Section 4.4.3), would likely create conditions under which the breaching of the barrier would be all but inevitable.

In order to combat the storm-induced creation of a new inlet in the study area, and the attendant adverse impacts that would result to Ocean Parkway and Great South Bay, the agencies that are involved in the dredging beach/nourishment project should take whatever actions are necessary to ensure that this project continues into the indefinite future. At the present time, funding for the beach nourishment portion of the project is authorized by the NYS Legislature on a periodic basis. The existing allocation of State funds will expire upon completion of the current project operations. Although the nourishment of the Jones Island shorefront has been informally assigned a high degree of priority, there is no guarantee that approval will be granted for any given request.

If funding is not procured to cover the State's portion of project cost, the ACOE may be compelled (under its primary obligation to maintain the navigability of the channel) to proceed with the dredging operation. Under these circumstances, the ACOE would be expected to dispose the spoil in the least costly manner, which usually means open water dumping. Given the scope of the impacts that would result from the formation of a new inlet through the barrier island, it is important that a more reliable mechanism by found for securing the financial resources needed to undertake beach nourishment operations. The New York State Department of State (January 1992) recommends that special legislation be adopted to require that suitable dredge spoil from ACOE projects is always used, when needed, for beach nourishment.

4.9.2 DUNE AND EMBANKMENT RECONSTRUCTION

Dune and embankment reconstruction is undertaken under the provisions of an emergency action plan to shore up the protective barrier along the south side of Ocean Parkway. This plan has been implemented by a committee consisting of the various governmental agencies that have jurisdiction in the area of active erosion, with primary objectives of maintaining the existing features on the barrier island and preventing the formation of a new inlet. This remediation program serves as an essential supplement to the beach nourishment project, and should be continued on an as-needed basis into the indefinite future.

4.9.3 MAINTENANCE OF THE SORE THUMB

As discussed in Section 4.4.1.B, the recent stability of the shoreline at Oak Beach has resulted primarily from the protection against tidal scouring that has been provided by the Sore Thumb since its construction in 1959. The continued stability of the Oak Beach shoreline is dependent on this structure being maintained, as required, against long-term scouring. Recent storms have caused a significant loss of material from the Sore Thumb, and the need for restoration appears to be imminent.

Since the Sore Thumb was constructed to achieve the express objective of mitigating shoreline recession that was being experienced by the residential properties at Oak Beach, the original construction costs for that project can be directly attributed to the existence of the Oak Beach communities; no such measures would have been necessary if Oak Beach were not developed. Similarly, any activities which are required to maintain or restore the Sore Thumb would be done so for the principal purpose of protecting the Oak Beach communities from shoreline erosion. Thus, the costs incurred to ensure the continued viability of this mitigation measure would likewise be directly attributable to the existence of the Oak Beach communities. In contrast, the storm damage protection that is afforded to the West Gilgo and Gilgo Beach communities by means of the beach nourishment and dune restoration projects is more or less incidental to the protection of Ocean Parkway and Great South Bay, which are resources of regional importance.

4.9.4 COASTAL EROSION HAZARD AREA LEGISLATION

Chapter 99 of the Babylon Town Code governs construction activities in the designated coastal erosion hazard area (CEHA), which pertains to the seaward-most row of houses in the Oak Beach communities. As discussed in Section 4.5.1.C, the Town Department of Environmental Control intends to use its permitting powers under this regulation to recommend the denial of a permit to reconstruct any house in the CEHA that has sustained storm damage comprising 50 percent or more of the pre-storm value of the house. However, the language of Chapter 99 is not clear with respect to this issue, which would not serve the Town well in the event that a denial of a post-storm restoration permit is challenged by the applicant.

The language of the law should be clarified regarding the use of Chapter 99 to phase out development in the CEHA, which is a goal that has been strongly advocated by NYSDOS (Anders, NYSDOS, December 28, 1992, telephone communication). A clause should be inserted that specifically states the circumstances under which a CEHA permit will be denied and presents the reasons that such action would be of benefit to the Town. Revising the law in this manner will not affect the applicant's right to seek relief under the existing appeal procedure or under Article 78 of the Civil Practice Law and Rules. However, the Town's case in an Article 78 proceeding would be improved if the ordinance explicitly defines the powers of the CEHA Program Administrator regarding the denial of permits for post-storm reconstruction and gives the environmental justification for such action.

As discussed in Section 4.5.1.C, it is likely that the post-storm reconstruction prohibition for CEHAs will soon be challenged for the first time in nearby towns as a result of the destruction caused by the 11-12 December 1992 northeaster. The Town of Babylon should closely monitor this situation as it develops to determine if the information arising from those proceedings can be applied to the subject Outer Beach communities or the local coastal erosion regulations that pertain thereto.

The NFIP provides a mechanism for the acquisition of storm-damaged strutures, if it is determined that financial compensation should be provided in lieu of allowing such structures to be restored. Part 77 of the FEMA regulations (44 CFR, Chapter 1) specify the criteria under which negotiations for acquisition can be commenced by FEMA, as follows:

- the property in question must be located in a flood risk area (which applies to the entire study area);
- the property must have been covered by a flood insurance policy under the NFIP at the time of the loss;
- the structure must be substantially storm-damaged; and
- the Town must agree to maintain the property as undeveloped open space following acquisition of the structure.

Since the Town of Babylon owns the land on which the houses in the subject communities are located, FEMA's obligation under these regulations would probably only pertain to the acquisition of the house. Any additional costs that may be incurred, such as payments to cover the resident's loss of the use of the land due to premature lease termination (see Section 8.2), are not discussed in the regulations, and likely would not be covered.

4.9.5 DUNE WALK-OVERS

Numerous pedestrian paths have been cut across the primary dunes along Ocean Parkway. Although some of these dune walk-overs are remote from the developed areas and clearly are not associated with the activities of the residents of the subject communities, it is equally evident that the existence of other walk-overs is due more or less entirely to pedestrian traffic from the West Gilgo and Gilgo Beach communities. Besides the ecological impacts that result from the destruction of dune grass (see Section 5.1.4), these paths diminish the protective capabilities of the dunes and render the back dune area more susceptible to storm damage.

Formal access to the beach from these two communities, which avoids impacts to the dunes, is provided by means of a single underpass at each location. The Gilgo underpass is centrally situated in the public parking area, while the West Gilgo underpass is at the extreme eastern end of the community. Both underpasses are inconveniently located for a large number of the community residents. Furthermore, the West Gilgo underpass has been almost completely obstructed with concrete debris and fill in an effort to prevent stormwaters from flowing through the underpass to the north side of Ocean Parkway.

Initially, it was thought that this problem could be mitigated by means of a program consisting of: the preparation of an informational brochure for distribution to the affected communities (i.e., West Gilgo Beach and Gilgo Beach); a dune management plan that includes the siting of dune walkovers and/or erecting pedestrian boardwalks over the dunes; additional signs and fences to discourage people from seeking passage over unprotected dunes; and enhanced enforcement of Section 81-29(3)(a) of the Town of Babylon Code, which prohibits pedestrian traffic on primary dunes and interdune areas except at specially designated dune crossing areas. These measures would also have been applied to those areas away from the subject communities where dune walk-overs exist (i.e., at the coves in Gilgo State Park that are used by summer boaters).

Site conditions have been drastically altered by the 11-12 December 1992 northeaster. Presently, very little of the original dunes remains along the ocean shoreline fronting the West Gilgo Beach community, and a six to eight-foot high erosion scarp has been cut into the dune face at this location. Although the Gilgo Beach shoreline escaped without sustaining a similar level of damage, this outcome was largely the result of the protective buffering provided by sand deposited during the ongoing beach nourishment project. Most of the sand that had been placed on Gilgo Beach was washed away by the storm, leaving the dunes in this area vulnerable to future erosion. Under these circumstances, addressing the dune walk-over problem has become secondary to restoring the storm-damaged sections of dunes. However, once the placement of artificial embankment has been completed, pedestrian traffic across this embankment should be monitored and mitigation measures should be routed over properly sited and constructed dune walkover structures.

4.9.6 LOCALIZED SHORELINE EROSION ON CAPTREE ISLAND

As noted in Section 4.5.3.C, a significant amount of shoreline erosion has occurred at the eastern end of the Captree Island community, as well as on the opposite shore of the State Boat Channel, apparently due to wakes generated by passing boats. This situation exists despite a posted speed limit of 5 mph. In order to curtail future shoreline recession in this area, it is recommended that the Town step up enforcement efforts, enlisting appropriate assistance from other agencies having jurisdiction in such matters (e.g., U.S. Coast Guard).

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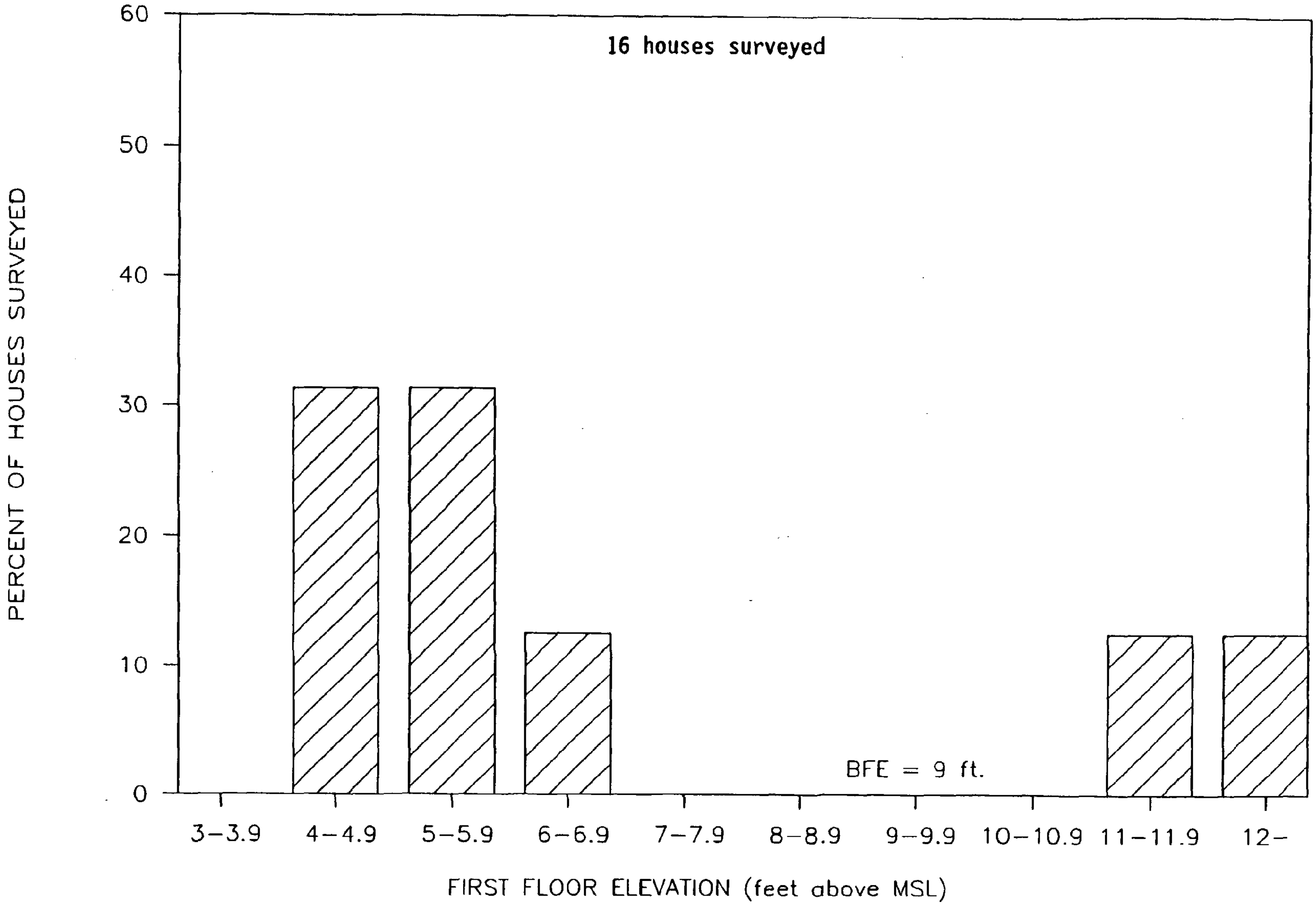

Figure 4-1: Distribution of first floor elevations in West Gilgo Beach community (V6 zone, BFE = 9 feet)

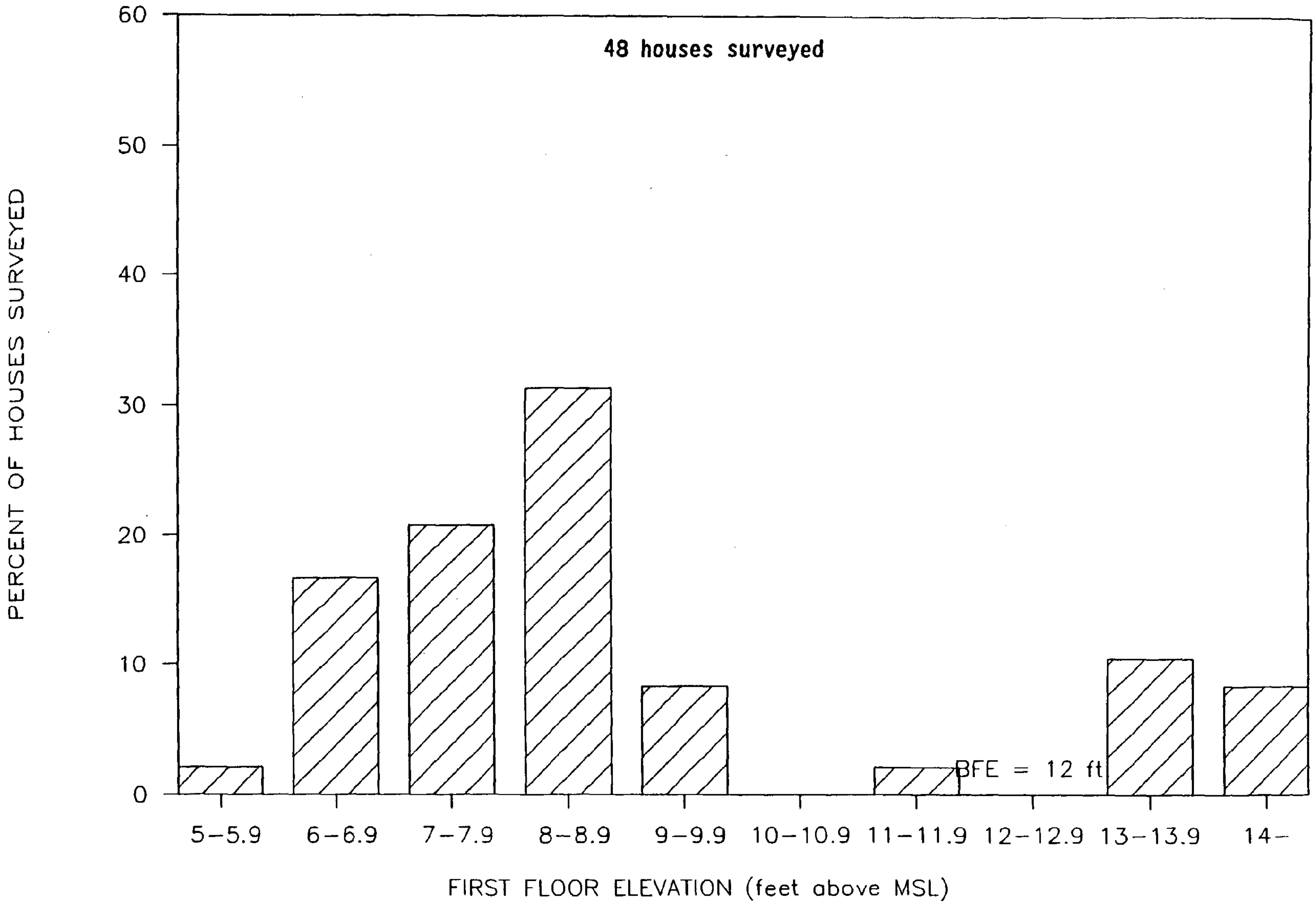

Figure 4-2: Distribution of first floor elevations in West Gilgo Beach community (V11 zone, BFE = 12 feet)

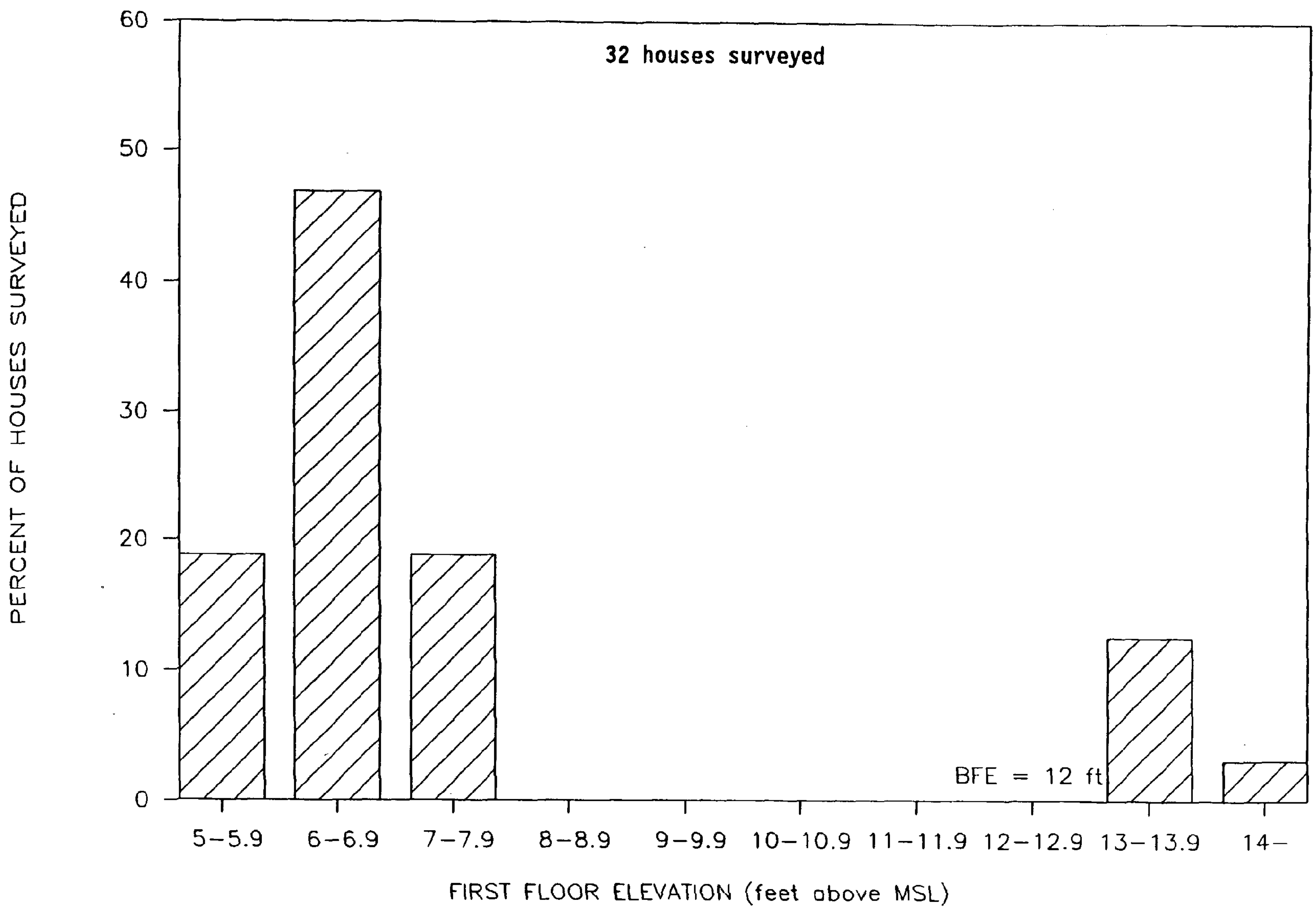

Figure 4-3: Distribution of first floor elevations in Gilgo Beach West community (V11 zone, BFE = 12 feet)

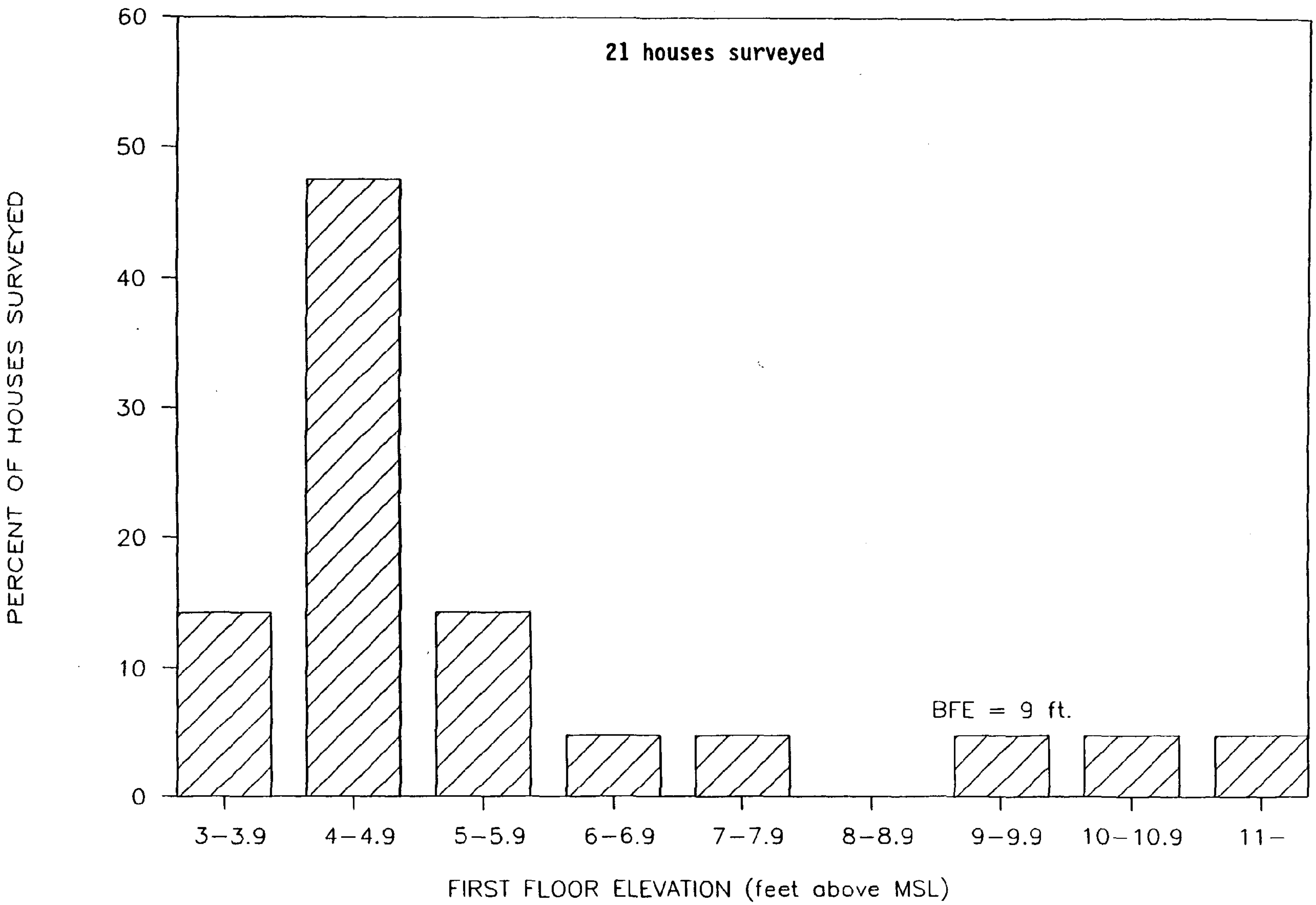

Figure 4-4: Distribution of first floor elevations in Gilgo Beach East community (V6 zone, BFE = 9 feet)

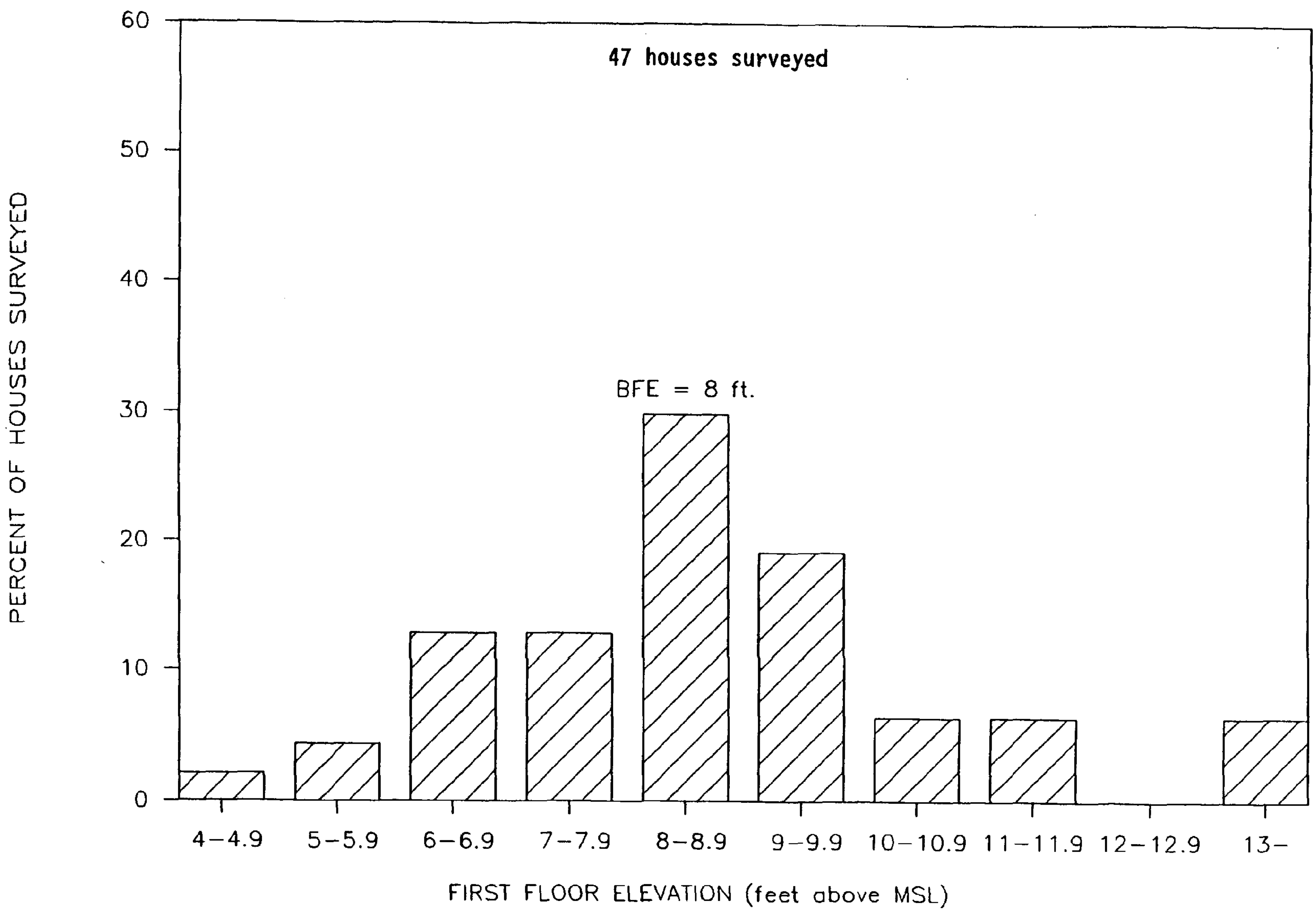

Figure 4-5: Distribution of first floor elevations in Oak Island community (A6 zone, BFE = 8 feet)

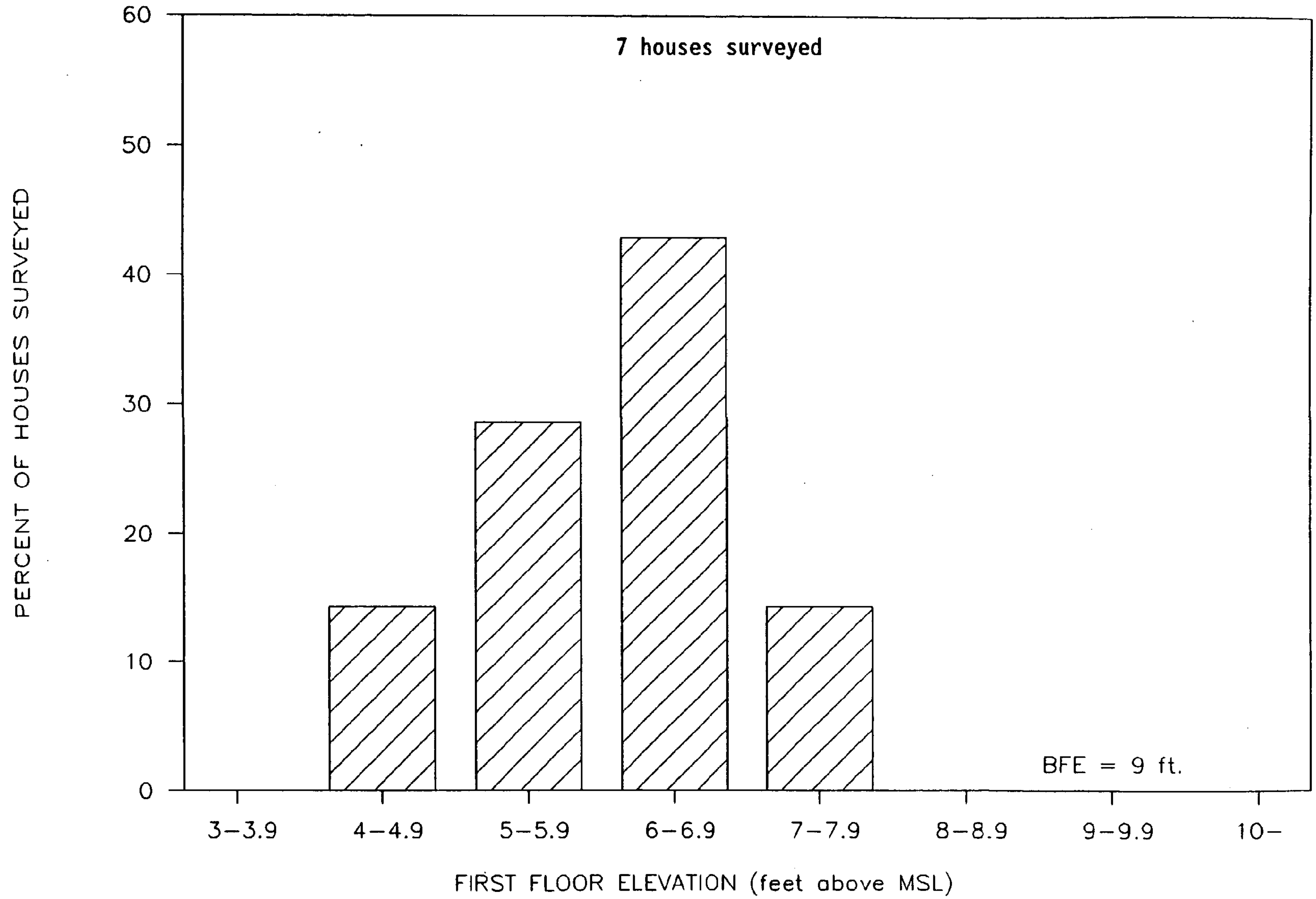

Figure 4-6: Distribution of first floor elevations in Oak Island community (V6 zone, BFE = 9 feet)

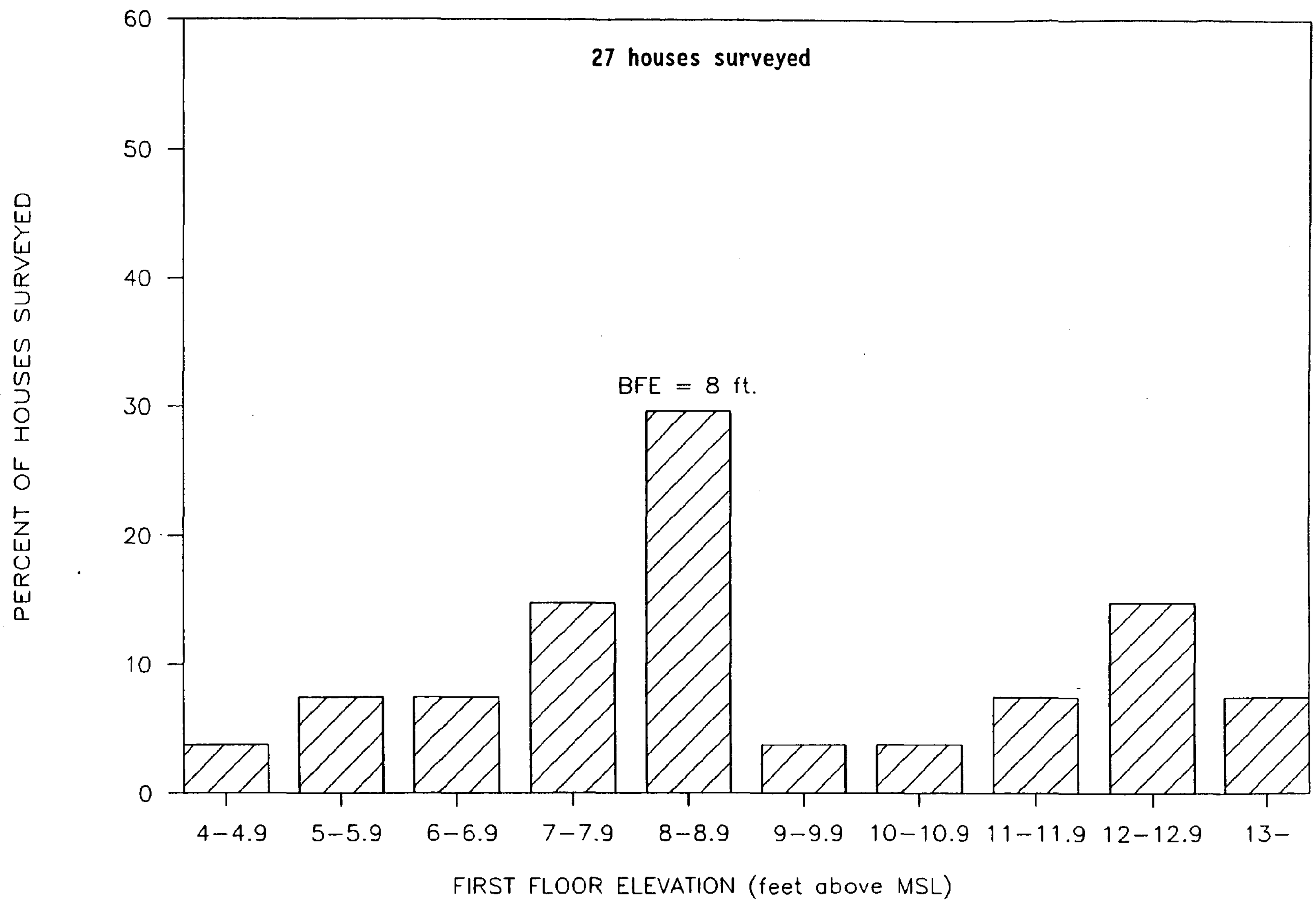

Figure 4-7: Distribution of first floor elevations in Captree Island community (A6 zone, BFE = 8 feet)

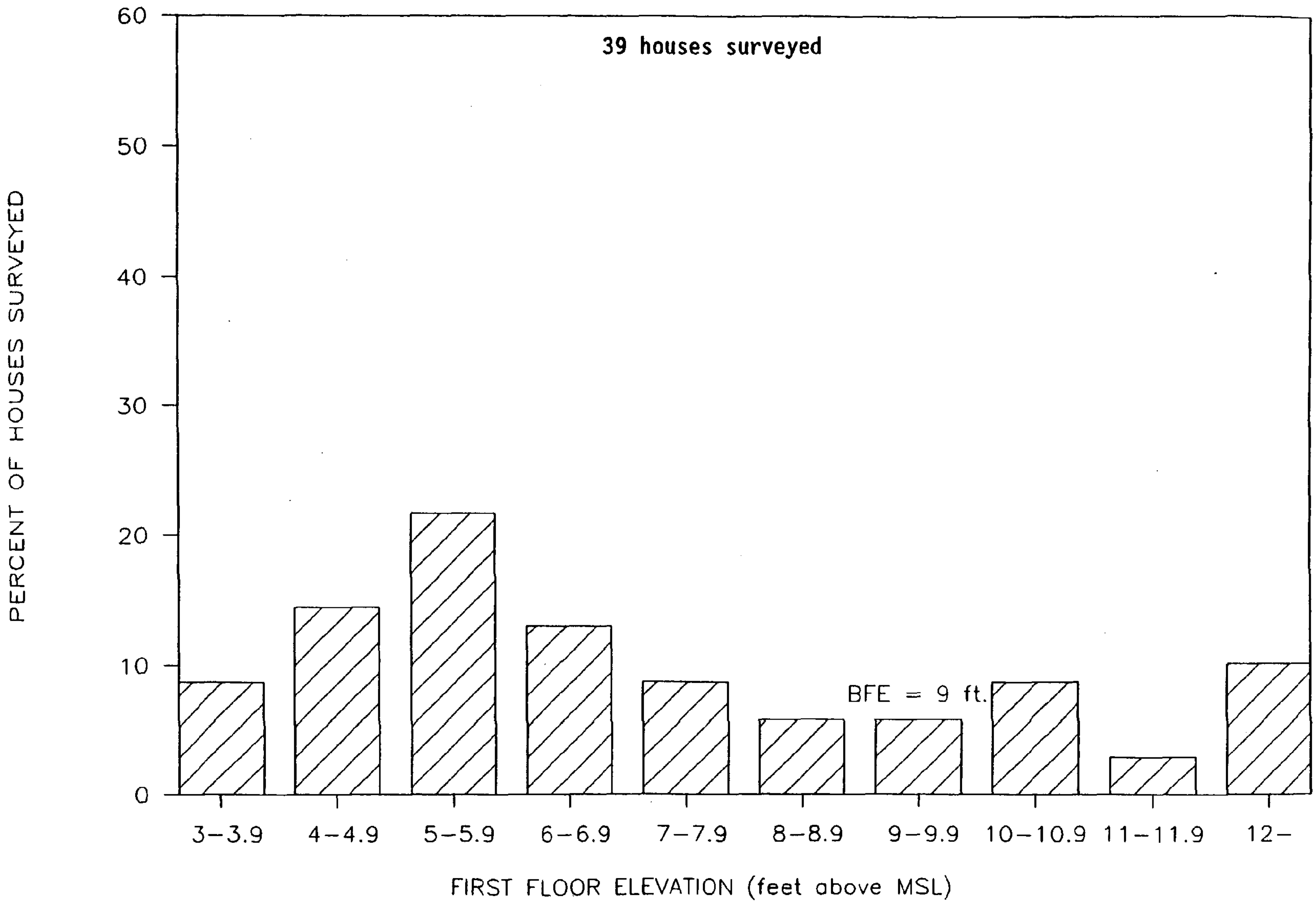

Figure 4-8: Distribution of first floor elevations in Oak Beach (unassociated) community (V8 zone, BFE = 9 feet)

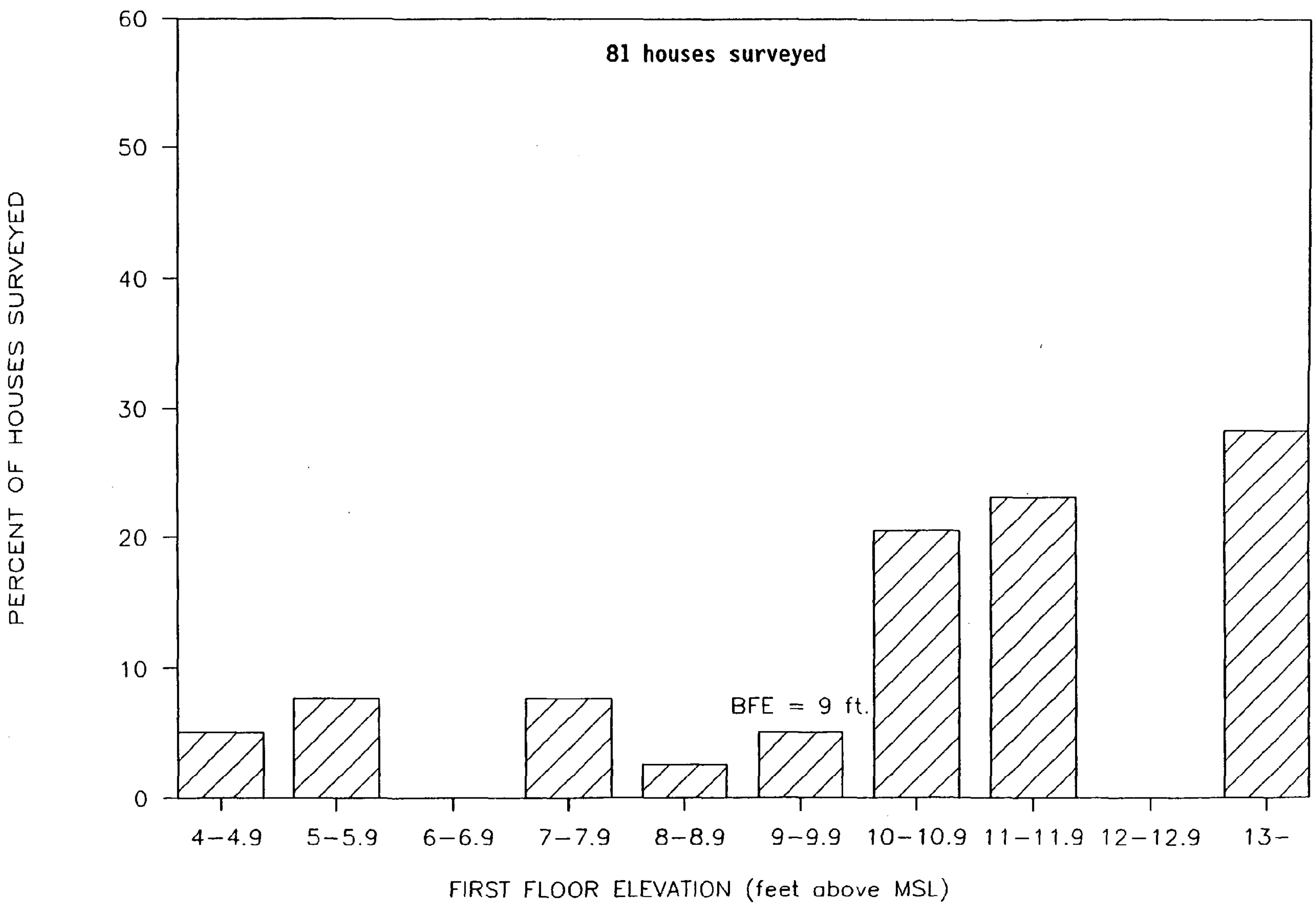

Figure 4-9: Distribution of first floor elevations in Oak Beach (unassociated) community (V9 zone, BFE = 10 feet)

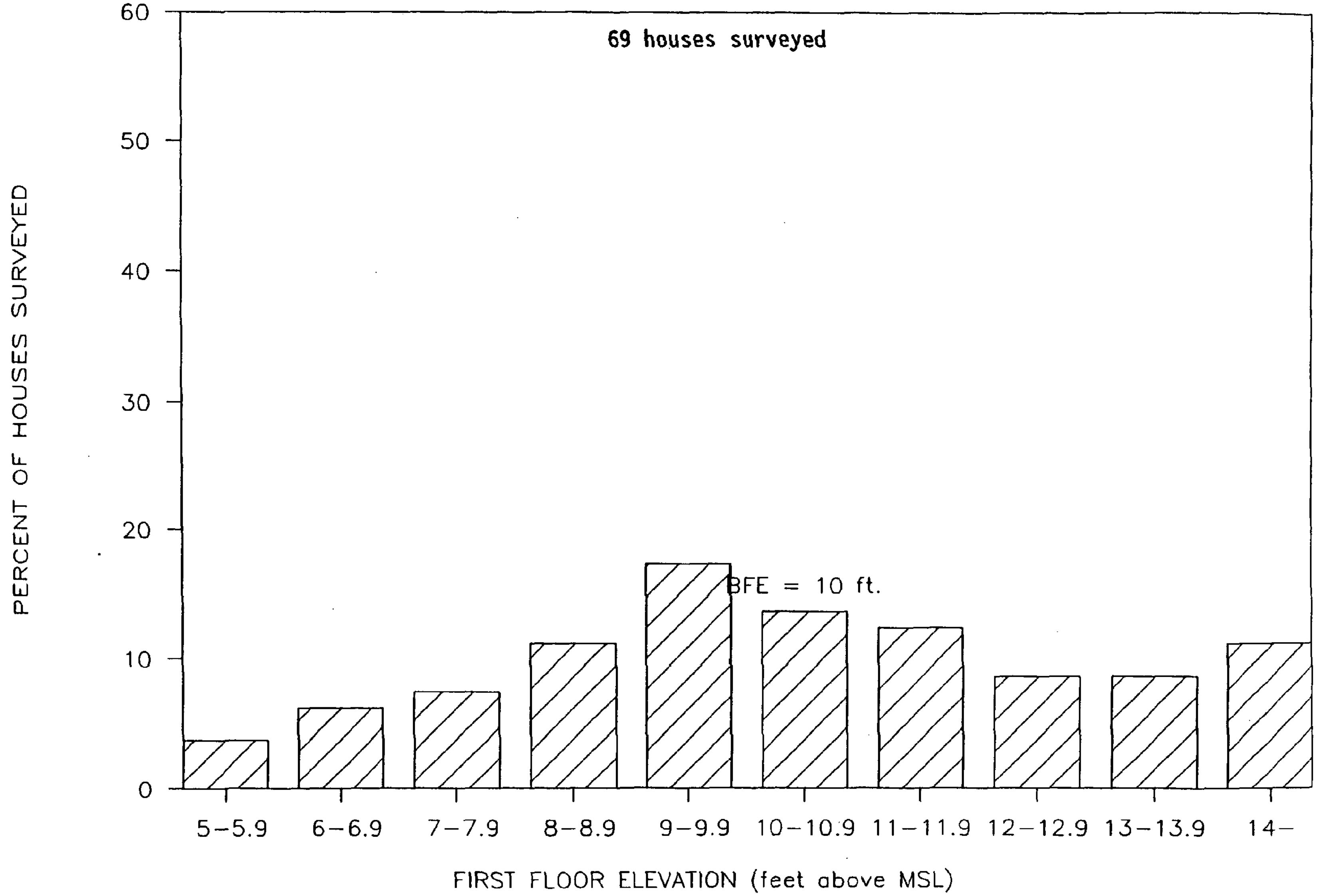

Figure 4-10: Distribution of first floor elevations in Oak Beach Association (V8 zone, BFE = 9 feet)

Table 4-1

Erosion Protection Structures in the Study Area

Community Name	Length of Natural Shoreline	Length of Bulkhead	Length of Shoreline with Groins and Revetments	Length of Other Shoreline	Total Length of Shoreline
West Gilgo Beach	600	640 (D= 250)	-----	-----	1,240
Gilgo Beach	-----	1,910 (D= 50)	-----	-----	1,910
Oak Island	2,210 (see notes)	3,710 (D= 330) (L= 510)	-----	30 (concrete wall)	5,950
Captree Island	1,280	2,590 (D= 610) (L= 430)	630	-----	4,500
Oak Beach	1,830	1,700 (D= 50)	1,430	150 (stone wall)	5,110
Oak Beach Assoc.	2,330	2,030 (L= 100)	1,030	-----	5,390
TOTALS	8,250	12,580 (D= 1,290) (L= 1,040)	3,090	180	24,100

Table 4-1 (continued)

Erosion Protection Structures in the Study Area

NOTES:

All lengths are in feet

L = low bulkhead (less than ± 2 feet)

* = loss of fill material behind bulkhead

D = deteriorated bulkhead

- West Gilgo Beach includes entire western shoreline of West Gilgo boat basin to northerly end of bulkhead
- Gilgo Beach includes entire length of shoreline within residential leased lots
- Oak Island includes entire length of shoreline within residential leased lots
- Captree Island includes entire length of shoreline within residential leased lots
- Oak Beach includes shoreline from westernmost pier at Oak Beach West to L-shaped pier at the Oak Beach Inn, excluding the ±2500-foot segment of stabilized shoreline along Oak Beach Avenue which does not contain houses
- Oak Beach Association includes shoreline from West Gate groin to the easternmost pier
- The length of natural shoreline on Oak Island includes a 500-foot segment in which residents have installed plywood sheeting on the landward side of the boardwalk as a makeshift erosion protection device.

SECTION 5

SECTION 5
INTERACTION WITH NATURAL SYSTEMS

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INTERACTION WITH NATURAL SYSTEMS

5.0 INTRODUCTION

The objective of this Section is to determine if the barrier and bay island communities have created any impacts on the natural systems within the study area. The introduction of residential development into an otherwise pristine area is bound to initially produce significant impacts on the local flora and fauna. However, some of these communities were first established nearly a century ago, and the primary purpose of this study is to assess the significance of the current impacts.

The production of this Section relied heavily upon a review of existing research and literature covering the study area. Supplementary field investigations were conducted to verify and update documented conditions. Each subsection provides an inventory of the natural amenity found within the study area, followed by a discussion of the community impacts on that amenity.

5.1 COASTAL BOTANY

5.1.1 TIDAL WETLANDS

A. *State Inventory and Classification*

Wetlands within the study area have been classified by NYSDEC as either tidal or freshwater, based on the vegetation they support. The type of vegetation is largely determined by the salinity of the surface water and the degree of inundation. The depth of water and the predominance of certain vegetative species serve as indicators to help distinguish between different types of wetlands.

Tidal wetlands constitute one of the most biologically productive of the natural systems within the study area. They serve as nurseries for fish and shellfish, they are vital to marine food production and provide valuable wildlife habitat. Tidal wetlands also serve several functions including flood and storm control, ecosystem cleansing and control of sedimentation. There are several regulatory mechanisms in place on the federal, state and local level acting to protect and preserve tidal wetlands. These are described at length in Section 5.5.

Tidal wetlands have been inventoried and mapped by NYSDEC on 1974 aerial photographs. These tidal wetland boundaries were officially adopted in 1977 when the State's Tidal Wetlands Regulations (Article 25 of the Environmental Conservation Law of New York State) went into effect. The tidal wetlands found within the study area consist of four major ecological zones:

• High marsh or salt meadow: Designated as HM on NYSDEC inventory maps. This is the uppermost tidal wetland zone usually dominated by salt meadow cordgrass (Spartina patens), and saltgrass (Distichlis spicata). This zone is periodically flooded by spring and storm tides, and is often vegetated by low vigor smooth cordgrass (Spartina alterniflora) and seaside lavender (Limonium carolinianum). The upper limits of this zone often include black grass (Juncus gerardi), marsh elder (Iva frutescens) and groundsel bush (Baccharis halimifolia).

• Intertidal marsh: Designated as IM on NYSDEC inventory maps. This vegetated zone lies generally between the average high and low tidal elevation, and is usually dominated by smooth cordgrass (Spartina alterniflora).

• Coastal shoals, bars and mudflats: Designated as SM on NYSDEC inventory maps. This zone includes areas that are exposed at low tide or covered by water to a maximum depth of one foot, and typically not vegetated by smooth cordgrass (Spartina alterniflora). This zone may merge with normally flooded shallow waters which support eel grass (Zostera sp.)

• Littoral Zone: Designated as LZ on NYSDEC inventory maps. This is a zone of open water which includes shallow bay bottoms with a maximum depth of six feet measured from mean low water elevation. This is a highly productive zone of great value to waterfowl, fisheries and shellfish.

In addition, the 1974 NYSDEC tidal wetland maps included designations for dredge spoil disposal areas (ds). Portions of Gilgo Island, Island (No. 8) north of Gilgo Island, Ox Island, East Nezarus Island, West Nezarus Island, Grass Island and Captree Island have been mapped by NYSDEC as dredge spoil areas. However, no such lands have been mapped by NYSDEC within or immediately adjacent to the coastal communities in the study area.

B. ***Apparent Differences with State Mapping***

Cashin Associates (CA) reviewed the 1974 NYSDEC Tidal Wetland Maps and compared these with the September 23, 1992 aerial photographs taken as part of this ecological study. Any apparent changes to the upland edge of the 1974 NYSDEC tidal wetland boundary and any gross changes in the type of vegetative cover were noted in the office and then checked in the field. Table 5-1 lists the plant species identified by CA growing in the tidal wetlands. Plates 2A through 2G depict a current approximation of the tidal wetland zones which border the coastal communities in the study area. The boundaries depicted have been determined primarily through photo interpretation and limited ground surveillance. These boundaries should not be construed as legal or state regulatory boundaries. NYSDEC is currently updating their 1974 Tidal Wetlands maps for Suffolk County, and projects that revised maps covering the Town of Babylon coastal areas will be available for public review in 1996 (Mushacke, November 12, 1992).

The major differences between the Figures in this report and the 1974 NYSDEC Tidal Wetlands maps are summarized as follows:

- A greater representation of IM in areas formerly mapped as HM by NYSDEC;

- An increase in the extent of IM fringe areas bordering the residential lots on Oak Island;

- A transformation from freshwater marsh to tidal wetlands within the Oak Beach Association area.

There are several probable causes for these differences. The initial mapping conducted by NYSDEC in the early 1970's may not have been as accurate as the methodologies currently used. Therefore distinctions between different vegetative zones are more readily apparent due to improvements in aerial imagery and mapping technology. Another causal factor could be a general increase in the amount of area on the south shore subject to tidal inundation. This may be due to any combination of possible factors affective wetland hydrology (e.g. changes in tidal range due to inlet maintenance, changes in drainage on the bay islands through improved ditching, and sea level rise). As mentioned earlier, NYSDEC is currently in the process of revising the upland/tidal boundary using infrared satellite imagery, low altitude helicopter flights and ground surveillance. Based on their recent work on Shinnecock Inlet and Moriches Bay, NYSDEC has also discovered a general landward movement in the tidal/upland boundary. Significant areas which were formerly classified as upland have gone through a transition and currently support HM and IM vegetation (Mushacke, November 12, 1992).

The transformation of one freshwater marsh to a tidal wetland in the Oak Beach Association was caused directly by man-made changes to the wetland hydrology. As shown in Plate 2G, the northern side of the Oak Beach Association development borders a large freshwater wetland system. This freshwater wetland drains through a main surface drainage ditch to a pipe culvert under the road at the western end of the community. According to the Suffolk County Bureau of Vector Control (SCBVC) this freshwater wetland historically drained directly to Fire Island Inlet. However, due to dune development this natural outlet was blocked (Sperry, SCBVC, November 10, 1992). This large freshwater wetland currently drains into a smaller marsh located to the west of the association entrance, between the double row of homes. This smaller marsh receives drainage through a series of surface ditches from undeveloped lots to the north and surface runoff from the development roadway. This smaller marsh drains through a pipe on the western end and outlets to a surface ditch further west. This main surface ditch also collects drainage from other ditches, and eventually joins a pipe and outlets to Fire Island Inlet approximately 1500 feet east of the Oak Beach Inn.

Due to a large number of mosquito complaints from residents in the Oak Beach Association, the surface drainage ditches and pipes were cleaned out by SCBVC approximately three years ago to improve drainage throughout this wetland system. The final pipe outlet was also replaced. According to SCBVC (Sperry, November 10, 1992), the original outlet contained a flapper valve, which prevented the backflow of saltwater up into the system during abnormal high tides and storm events. The new pipe outlet has no flapper valve, thereby permitting occasional saltwater inundation. During field reconnaissance, this westerly located smaller wetland was found to support tidal marsh (HM) vegetation including saltmeadow cordgrass (Spartina patens), saltgrass (Distichlis spicata) and low vigor common reed (Phragmites communis). The eastern end of this wetland, which is presumably slightly higher in elevation, supports a taller stand of common reed. It is fairly common to find a fringe of freshwater marsh vegetation bordering the upper edge of a tidal marsh. This is shown in Plate 2G.

C. ***Impacts to Tidal Wetlands***

Historically, the tidal wetlands within the study area have constituted the main component of the natural ecosystem which experienced the greatest loss and alteration due to past dredging and filling activities related to the construction of Ocean Parkway, the creation of the State Boat Channel, and residential development. A historical perspective of the vegetative changes that resulted from these activities is discussed in detail in Section 5.3.1. However, it must be noted that the majority of the existing homes have been constructed on fill material that was placed on top of tidal wetlands before the state regulations were promulgated in the mid 1970's. In addition, many homes in Gilgo Beach East and Oak Island, and a few on Captree Island occupy lands that are currently classified as tidal wetlands.

The impacts of these residential communities on tidal wetland vegetation can be categorized as either direct or indirect. Direct impacts include those activities which residents may undertake which directly alter the tidal botany or productivity of the tidal ecosystem within their community. Such activities include: mowing, cutting or otherwise removing tidal wetland plants; exposing tidal wetlands to traffic (i.e., foot, vehicular, boat, etc.); and disposing of waste materials on or immediately adjacent to tidal wetlands. Based on CA's field investigations, the majority of the communities currently have had no or limited direct impacts on tidal wetlands. Mowing activities were generally limited to residences in Gilgo Beach East and Oak Island, and off-road parking areas on Captree Island. This is discussed further in Section 5.3.5.

CA found little to no traffic impacts on tidal wetlands in any of the residential communities. No pattern of regular vehicle traffic or footpaths were found in the tidal wetland areas adjacent to the communities. Boat access to Oak Island has apparently had no negative impact on tidal vegetation. IM and HM species have reestablished a tidal wetland fringe along the unprotected shoreline, behind deteriorated structures and even in front of some bulkheads on Oak Island, despite the frequent occurrence of boat wakes.

Many of the older homes in the East Gilgo community still have active outhouses to dispose of sanitary wastes. These privies are located behind the homes, in or adjacent to tidal wetlands. Sanitary disposal systems for homes in other communities typically consist of underground septic tanks and leaching pools, or some modification thereof (Reynolds, SCDHS, October 16, 1992). Although not quantified for the purposes of this study, these systems have the potential to introduce significant loads of ammonia nitrates, coliform bacteria and other pathogens into the tidal wetland system. CA did not identify any dumping or disposal of solid wastes in the community tidal wetland areas.

Indirect impacts on tidal wetlands vegetation include activities which residents may undertake in adjacent areas that ultimately impact tidal wetlands. Such activities include the application of fertilizers and the mosquito control practices (spraying and ditching) of the SCBVC. These practices are described in further detail in Section 5.3.4. SCBVC activities are conducted on an as-need-basis, based upon complaints received from residents and property owners.

D. ***Marsh Grass Density and Biomass Studies***

In January of 1991, EEA, Inc. completed a study which compared the density of saltmarsh cordgrass growing adjacent to developed community areas with outlying undeveloped areas. The developed community areas were represented by tidal marshes lying north of the residences on Oak Island and Captree Island. The undeveloped areas were represented by tidal marshes on the bay islands of Gilgo Island, Cedar Island, Grass Island and East Fire Island. The EEA study conducted actual shoot counts of s. alterniflora, taken in randomly distributed sample areas of a uniform size (0.25 m). The study reported that no statistically significant difference was found in marsh grass densities in the developed versus undeveloped areas. Furthermore, the differences which were recorded apparently resulted from factors other than the presence of residential structures, such as differences in elevation or substrate composition.

In a subsequent study, EEA, Inc. quantified the productivity of IM zones in both developed and undeveloped areas (EEA, Inc., November 1992). Marsh grass clippings were taken from similar random, uniform sample locations during June and July of 1992. Oven-dried weights were determined and these values were subject to statistical analysis. Findings of the biomass study corroborated the EEA marsh grass density study. No significant differences was found between the developed and undeveloped areas in terms of s. alterniflora biomass. Both EEA, Inc. studies are contained in Appendix C.

The EEA data are consistent with the findings of CA's map and field analyses. Whereas CA's investigation indicates that the subject residential communities have not significantly impacted overall wetlands species distribution in the study area, EEA's study indicates that wetland biomass productivity does not vary significantly between developed and undisturbed areas.

5.1.2 FRESHWATER WETLANDS

A. *State Inventory and Classification*

In contrast to tidal wetlands, freshwater wetlands are not mapped or classified by NYSDEC into different ecological zones. However, vegetative cover types are used to distinguish between freshwater wetlands and other areas. The presence of several vegetative species are fairly good indicators of the occurrence of freshwater wetlands, including: wetland trees such as Red Maple (Acer rubrum), Willows (Salix spp.), Swamp White Oak (Quercus bicolor), Silver Maple (Acer saccharinnum) and Shadbush (Amelanchier arborea); wetland shrubs including Dogwoods (Cornus spp.), Swamp Rose (Rosa palustris), Sweet Pepperbush (Clethra alnifolia), Spicebush (Lindera benzoin), Cranberry (Vaccinium macrocarpon), and Highbush Blueberry (Vaccinium corymbosum); wet meadow species such as Rushes (Juncus spp.) and Sedges (Carex spp.); and various emergent and submerged plants including Cattails (Typha spp.), Bulrushes (Scirpus spp.), Loosestrife (Lythrum spp.), Pondweeds (Potamogeton sp.) and Water Smartweed (Polygonum amphibium).

Pursuant to the passage of the Freshwater Wetlands Act (Article 24 of the Environmental Conservation Laws of New York) in 1975, NYSDEC inventoried the freshwater wetlands in Suffolk County. The state regulation is discussed in detail in Section 5.5. The state maps indicate the presence of only one freshwater wetland system within the study area. This system, which is located north of the homes in the Oak Beach Association, consists of a larger wetland to the east and a smaller wetland to the west. The NYSDEC identification number for this wetland system is BW-8 (as depicted on the Bay Shore West Quadrangle map). As discussed in Section 5.1.1, the western portion of this system has since reverted to a salt marsh, due to alterations of drainage and hydrology. The eastern portion of this wetland system is a boggy shallow marsh, primarily covered with peat moss and cranberries, various rushes and sedges in the middle and the west, and cattails and common reed in the east.

B. *Apparent Differences with State Mapping*

CA has identified several other areas of freshwater wetlands within and adjacent to the coastal communities of the study area, which were not originally mapped by NYSDEC. Two are located within the West Gilgo Beach community, as depicted in Plate 2A, and another small area is located east of the Oak Beach Association within the backdune area. Although not accessed during the course of this study, it is highly likely that additional freshwater wetlands are located at the northeastern end of Oak Island, between the wooded uplands and tidal marshes. According to discussions with local residents, this area was disturbed years ago in efforts to install wells and/or piping.

Table 5-2 lists the vegetative species found growing in the freshwater wetlands of the study area. The larger wetland identified by CA within the West Gilgo Beach community is dominated by large cranberries, various ferns, highbush blueberry and arrowwood. It appears that the majority of the residents are generally not aware of the presence of this wetland, due to the fact that it generally occupies undeveloped lands to the north of the community and that approximately one acre of it has been meticulously kept mown for a ball field. One resident, however, indicated that Glossy Ibises return to this area every year presumably to forage (Kluesener, October 9, 1992). Although this area is not currently protected by NYSDEC as a freshwater wetland, it supports a vegetative structure that would warrant future regulation. This is discussed in Sections 5.3.5, 5.5.3 and 5.6.2.

C. ***Impacts to Freshwater Wetlands***

The freshwater wetland at Oak Beach Association is generally undisturbed by human activities, with the exception of occasional ditching conducted by SCBVC. Adjacent upland areas were found to be used by Northern Harriers for feeding and roosting during CA's field investigations. According to the President of the Oak Island Beach Association, Inc., C.D. Plaissay, this freshwater wetland offers unique passive recreational opportunities to the residents and members of the National Audubon Society and other bird watchers (November 17, 1992).

The freshwater wetlands identified by CA at West Gilgo Beach have experienced some degree of disturbance. The smaller wetland located in the backdune area northwest of the community is relatively undisturbed; there were no trails evident to this wetland area and anyone walking to it must blaze through a prickly thicket of raspberries and swamp rose. A portion of the larger freshwater wetland at West Gilgo Beach borders Ocean Road. This southern edge is prone to dumping, which is also evidenced further west in the backdune area. As discussed earlier, the greatest degree of disturbance is experienced at the southwestern end of this wetland, which borders and partially occupies the community ball field. Mitigation alternatives for impacts on freshwater wetlands are discussed in Section 5.6.2.

5.1.3 UPLANDS AND WOODLANDS

The land areas located up-gradient of wetlands are considered collectively as uplands for the purposes of this study. The vegetation of these upland areas consists primarily of thicket- forming shrubs including bayberry, various sumacs, beach plum, pasture rose, groundsel-tree, highbush blueberry and the shrub form of poison ivy. These plans can be found growing within the inhabited community areas as well as the undeveloped areas. Tree species that are found growing at slightly higher elevations include fire cherry, black cherry, American holly, Eastern redcedar, and shadbush.

The upland vegetation throughout the study area consists primarily of shrub thickets. Woodlands are fairly sparse within the study area, presumably due to the lack of elevation above sea level and/or the groundwater table, and the lack of loamy soils to support such growth. Woodlands, therefore, generally appear as distinct patches on the coastal landscape. Large patches of native woodlands can be found on the central portions of Oak Island. These woodlands are nearly impenetrable due to the presence of fringing shrub thickets and intertwining bittersweet and greenbrier vines. The plant species which were found in the Oak Island woodlands are listed in Table 5-3.

The linear groves of Japanese black pine trees which cover the state right-of-way bordering Ocean Parkway are not considered native woodlands. This ornamental species was widely planted by the state from the 1960's until the 1980's. A disease has attacked this monoculture and is spreading rapidly, as described in detail in Section 5.3.3. The continued presence of these pine groves in the future landscape of the study area is at best questionable. The initial introduction of this plant species as a monoculture took place somewhat independent of the community settlements. However, the wide distribution of this species throughout the community areas indicates that individual residents and community groups also planted Japanese black pines.

The introduction of ornamental plant species (including Japanese black pine) has had an impact on the vegetative communities which are native to the study area, as discussed further in Sections 5.1.5, 5.3.1 and 5.3.2. Other impacts to the upland vegetation and woodlands within the study area include: the clearing and removal of native vegetation for the siting of homes, roads and pathways; and the dumping of yard wastes and other solid waste materials in undeveloped upland areas. Plates 2A, 2B, 2E and 2G indicate the locations of off-road vehicular paths and walkways which have replaced areas of native upland vegetation in the vicinity of the subject communities. The secondary impacts of frequent human disturbance are more significant than the primary impact of loss of vegetation from upland areas and woodlands.

5.1.4 DUNES AND BEACHES

Dunes and beaches represent the harshest environments of the natural coastal ecosystems for plant establishment. Plants growing in these areas must withstand extremes in soil temperature, direct sunlight, drought, salt spray and the abrasive action of sand grains which are wind borne. There is typically little vegetative diversity along the beach fronts and foredune areas, where plants experience the most severe conditions. Only beachgrass, seaside goldenrod, sea rocket and occasional patches of saltmeadow cordgrass (at lower elevations subject to salt spray and occasional flooding) were found along the beaches and foredunes within and immediately adjacent to the communities of the study area.

Plant diversity increases just behind the dune crest where the wind velocity drops and the temperature and moisture regimes are slightly moderated. Table 5-4 lists many of the plants found growing in the back dune locations within the study area. Beachgrass, little bluestem and beach heather are the dominant dune ground cover species throughout the study area. Jointweed was also dominant in the dune areas situated further from the shoreline, such as found within the Oak Beach Association and West Gilgo Beach communities. The locations of dune areas are depicted on Plates 2A, 2B, 2E and 2G. Approximately half of the Oak Beach Association community (Plate 2G) and a minor portion at the western end of the Oak Beach community have been developed on top of dune areas.

According to the Nature Conservancy and New York Natural Heritage Program, several rare plant species are typically associated with dune and beach environments. Two of these species, seabeach amaranth (Amaranthus pumilus) and seabeach knotweed (Polygonum glaucum), have been recorded as occurring within the study area, outside of the residential communities. The seabeach amaranth is an annual plant, typically found on actively accreting beaches. The seabeach knotweed is also found on beaches, but may tolerate more rocky areas. A rare plant survey has not been conducted within the community areas to verify the presence or absence of these and other species. The Nature Conservancy suggested that the extent of four additional rare and vulnerable plant species should be verified, including: red pigweed (Chenopodium rubrum); evening primrose (Oenothera oakesiana); golden dock (Rumex maritimus); and roland sea-blite (Suaeda rolandii) (Antenen, The Nature Conservancy, September 18, 1992). The primary impacts to dune and beach plants caused by human habitation in these areas include: the removal and replacement of native species with other adaptable plants within the residential communities; the spread of typically ornamental species to the fringes of these dune and beach areas; and the destruction of dune plant species due to concentrated foot traffic. The introduction of ornamental and non-native plant species through residential landscaping is discussed in Section 5.1.5. The spread of these species to outlying natural areas is discussed in Section 5.3.2

Dune and beach vegetation is particularly vulnerable to foot and vehicular traffic due to the extreme environmental conditions that the plants grow in. Concentrated foot traffic has had a significant impact on the dune vegetation as well as accelerating the potential for dune erosion. As depicted in Plates 2A and 2B, footpaths through the dunes have seriously impacted the vegetation which is essential for maintaining the stability of the dunes. CA inventoried the occurrence of dune walkovers and found the greatest concentration at the central and western portions of the study area. Unpaved footpaths lead from the road ends and originate from directly behind residential homes in the Gilgo Beach East, Gilgo Beach West, and West Gilgo Beach communities. In some cases small ladders have been erected and holes have been cut in the fenceline set on the northern boundary of the state right-of-way. Directly opposite these pathways are barren areas on the dunes located across Ocean Parkway. In several locations, these traverses are directly in line with known occurrences of the rare plant species discussed earlier, seabeach amaranth and seabeach knotweed. Walkovers also occur to the east of these community areas, originating from the shoreline at Hemlock Cove on the bay side of the barrier.

5.1.5 URBAN VEGETATION

During field investigations, CA noted the types of plant materials found growing within the community residential areas. These are listed in Table 5-5. Several species listed are native to the Long Island area. These may be indicative of the types of vegetative cover which existed prior to development or native species which have recolonized the area after construction took place. For the purposes of this study, the remaining species in Table 5-5 are collectively referred to as "urban vegetation". These represent non-native or ornamental plant materials which were introduced into the community areas primarily for landscaping purposes.

The predominant tree species planted in the community areas (as well as the state roadway right-of-way) is Japanese Black Pine. This one plant accounts for over 80 percent of the mature trees found growing in the residential areas. Monocultures, or plantings of a single species type, are highly discouraged in modern landscape practices to prevent widespread losses in the event of disease or insect infestations. The Japanese black pine has already succumbed to such a scourge. This is described in detail in Section 5.3.3. Unfortunately, Japanese black pine plantings have replaced native tree species in the community areas, and their losses will produce a rapid decline in the percentage of tree canopy cover. This will eventually impact the types of wildlife species using the area.

Conversely, shrub plantings in the community areas have been found to be fairly diverse. In the communities of Oak Beach, Oak Island, East Gilgo and West Gilgo Beach, native shrub species such as bayberry, sumac and beach plum account for nearly half of the shrub-type vegetation. In addition, several non-native but relatively trouble-free naturalizing plants have been introduced including salt spray rose, autumn olive, and Russian olive. Privet is widely planted in the West Gilgo community. Although this is currently regarded as a maintenance and trouble-free plant, its wide representation could present a problem if hit by disease.

Groundcovers in the community areas have also been found to be diverse. In areas receiving little disturbance or maintenance, native grasses such as little bluestem, broomsedge and switchgrass predominate along with patches of beach heather. Several residents have also planted beachgrass plugs along the shoreline areas in Captree Island, Oak Beach and Oak Beach Association.

Many of the landscape plants introduced into the community areas have the potential to readily propagate and spread into the outlying native areas. CA's findings on this issue are discussed in Section 5.3.2. For the purposes of this study, CA identified the extent of urban vegetation within and immediately adjacent to the community areas. This is depicted in Plates 2A through 2G. Included within the urban vegetation boundary are areas planted to non-native and ornamental species (excluding the Japanese black pine stands bordering the state roadways), areas which have received routine maintenance in terms of mowing, irrigation and/or fertilizer applications, and disturbed areas adjacent to community docks, parking lots, walkways and filled groin areas. The vegetation found growing in these disturbed areas consists of typical meadow-type plants, weeds and beach species. These are listed in Table 5-6. All areas lying outside of this urban vegetation consist of native cover types.

5.2 EXISTING WILDLIFE RESOURCES

5.2.1 ENDANGERED, THREATENED AND SPECIAL CONCERN SPECIES

A. *General Discussion of Listed Species*

The Jones Beach barrier and bay islands within the study area are host to numerous species of wildlife which are currently listed by NYSDEC as Endangered, Threatened or of Special Concern. It is interesting to note that all of these are avian species. There are several layers of regulation at the federal, state and local level which afford protection for these rare birds. Such legislation and regulations are discussed in detail in Section 5.5.

NYSDEC defines "Endangered" species as any native species in imminent danger of extirpation or extinction in New York. The study area contains breeding habitat for three endangered species including Piping Plover, Least Tern, and Roseate Tern. Two other endangered species, Bald Eagle and Peregrine Falcon, are reportedly infrequent visitors to the Babylon coastal area.

Native species which are likely to become endangered within the foreseeable future in New York, are considered "Threatened" species by NYSDEC. Two threatened species, Common Tern and Northern Harrier, are known to breed within the study area. Osprey, also a threatened species, has successfully bred further east along the south shore of the mainland coastline in Islip and Brookhaven (Andrle and Carroll, 1988). In anticipation of increased nesting activity by Ospreys along the barrier and bay island areas, man-made timber nesting platforms were erected within the study area at Seganus Thatch, Oak Island and West Gilgo Beach.

"Special Concern" species are native species which are not yet recognized as endangered or threatened by NYSDEC, but are documented as being of concern with regard to their continued welfare in New York State. According to NYSDEC, these species could become endangered or threatened in the future and warrant close monitoring. Six species of Special Concern reportedly utilize habitats within the study area for breeding and/or over-wintering; these include Black Rail, Common Loon, Eastern Bluebird, Grasshopper Sparrow, Least Bittern, and Short-eared Owl.

Specific information was gathered on these rare species from the New York Natural Heritage Program, NYSDOS, NYSDEC, the National Audubon Society, and the Town. As is customary, the exact nesting locations of these rare species will not be disclosed in this document to protect the viability of these critical habitats. However, general information will be discussed to promote a better understanding of the species biology, habitat needs and management considerations. The following discussion centers on the endangered and threatened species that are known to breed within the adjacent undeveloped areas of the barrier and bay islands in the Town of Babylon.

B. ***Piping Plover***

As migratory shorebirds, Piping Plovers return to their breeding grounds in the study area between mid-March and mid-April. Piping Plovers frequently nest within Least Tern colonies but generally at great distances (90 to 210 feet) from other Piping Plovers. Nests are formed within shallow depressions in the sand, typically located between the high tide line and foredune areas; or on unvegetated dredged material if the surface is composed of sand, pebbles and shell fragments (NYSDOS, 1991). Egg laying and brooding may occur anytime between mid-April through July, with juveniles and fledglings present from late May through mid-August. Piping Plovers leave Long Island by the end of August to early September (Andrle and Carroll, 1988).

Piping Plover chicks are precocious, and shortly after birth, will follow their parents down to the intertidal zone to feed on crustaceans, mollusks, worms and insects. The locally common practices of beach raking and grooming conducted during the juvenile stages of this species pose an extreme threat to young birds, due to the creation of deep tire tracks and the deposition of rubbish piles between the nesting and feeding areas (Antenen, The Nature Conservancy, September 18, 1992). Plover chicks are extremely vulnerable during their first 30 days of life before they learn to fly. Unfortunately, the majority of young hatch around Memorial Day weekend and are barely ready to fly by the Fourth of July holiday - coincident with the two peak beach use days of the summer. Disturbances by beach-goers, pets and vehicles during this time can destroy birds or cause adults to abandon otherwise suitable nest sites (NYSDOS, April 1991).

C. ***Least Tern***

Long Island is the only breeding area within New York State used by this migratory, colonial-nesting shorebird. Least Terns generally arrive in the study area by early May, and tend to return to colony sites which were used the year before. Least Tern nesting habitat is similar to areas used by the Piping Plover. Least Terns will generally avoid beaches that have less than 30 feet between high tide mark and vegetated dunes, but it is not uncommon to find colonies in low lying areas subject to flooding. Colonies may contain anywhere from 2 to 600 pairs and may occupy several hundred feet of beach front (NYSDOS, April 1991).

Egg laying typically begins by the second week of May and most eggs hatch by late June. Chicks are fed by their parents on the nest for about one month. Least Terns forage for sand lance and other small fish in freshwater and brackish ponds, estuaries, bays and the ocean, often at considerable distances from the colony. After leaving the nest, young tern chicks move readily around within the colony. Fledged chicks may be found in the study area until late August, congregating on the beaches prior to migration. Least terns generally leave the study area by early September.

D. ***Roseate Tern***

Similar to Least Terns, the Roseate Terns in New York have been reported as exclusively nesting on Long Island. Roseate Terns generally arrive in the study area by mid-May and establish sub-colonies within Common Tern colonies. Roseate Terns typically select nest sites located in sandy areas on islands or the barrier beach with about 80 percent vegetative cover consisting of beachgrass and other herbaceous plants. Egg laying begins almost immediately after the nest site is selected. Most chicks hatch by late June, are fed by their parents, and fledge and migrate the same time as Least Terns. Roseate Terns forage for small fish (2 to 4 inches in length) in clear bay waters, inlets, tidal rips and open ocean waters within approximately one and one-quarter miles of shore (NYSDOS, April 1991).

E. ***Common Tern***

In 1985, over one-quarter of New York's breeding population of Common Terns nested within the study area (Andrle and Carroll, 1988). Common Terns select nesting sites similar to Piping Plovers and Least Terns; however, they will also nest in high marsh areas on the bay islands above the rack line. Common Terns return to their breeding grounds in early May. Egg laying and incubation has been reported as occurring anytime from mid-May through mid-August, and young are present from early June through early September. Rearing is similar to Least and Roseate Terns. Common Terns forage in areas similar to Roseate Terns, but feed primarily on schools of fish driven to the water surface by feeding bluefish. The literature suggests that bluefish are better competitors for the same food source, and that the population levels of bluefish may dictate the degree of Common Tern reproductive success in an area within a given breeding season (NYSDOS, April 1991). Apparently, Common Tern populations are in delicate balance with bluefish populations; Common Tern numbers tend to be somewhat controlled by elevated and depressed local bluefish concentrations. Common Terns typically leave Long Island by early October, nearly a month later than Roseate and Least Terns.

F. ***Northern Harrier***

The Northern Harrier, or "marsh-hawk" as it is commonly called, is a raptorial bird which primarily feeds on Voles (Microtus sp.) in the study area. A five year study was conducted on the Northern Harrier population which occupies the study area in close proximity to the residential developments. This study found that the adult male Harriers overwinter in the study area, along with juveniles born the same year. Adult female Harriers generally migrate. When the females arrive by the third week of February, they find the males already occupying historic breeding territories. New nests are generally built on the ground near the upland fringe of tidal marshes, in dense stands of common reed or thickets of mixed common reed and poison ivy. Egg laying occurs sometime between late April to early May. Incubation lasts approximately 35 days. Young are fed in the nest for about 40 days, with the greatest occurrence of juveniles fledging from the nest sometime in mid-July. Adults continue to feed the young for 3 to 4 weeks until they leave the nesting territory (England, 1989).

The Harrier study found that nesting pairs raised only one brood per season, and that if a nest failed, the Harriers usually left the area within two days, and did not attempt to re-nest. Predation and human disturbance were cited equally as the primary causes for nest failure. An annual mean of 12 nests were identified during the course of this study, with the greatest nesting density occurring at Oak Beach, and secondly at Captree Island. The study cites that habitat loss (particularly in fresh and tidal wetlands) and increasing human population encroachment on Harrier breeding areas as significant factors determining Harrier breeding success. The study found that the Harrier population appeared to be stable within the study area; and "that if the breeding habitat remains intact, no serious change for the worse in breeding numbers is anticipated" (England, 1989).

5.2.2 BIRDS

The Jones Beach barrier and bay islands within the study area are host to over 180 species of birds. Approximately 100 species are believed to breed within the study area and over 90 species will over-winter there or use the area to feed and roost during migration. Table 5-7 provides a comprehensive list of avian species which reportedly utilize the study area. This list has been compiled from several technical documents (as referenced in the table) and has been reviewed by NYSDEC (Scheibel, NYSDEC, November 2, 1992). Also noted in Table 5-7, are 40 species which CA identified while conducting various field investigations for this study.

Species which are indicated in Table 5-7 as being present during both the breeding season "B" and winter season "W" are considered residents of the study area. Those which are only present during one season or the other, "B" or "W", are considered transients or migratory species. In some cases, species with no particular designation are included in the list. This indicates that the species is either an uncommon visitor to the area, or that available data was lacking on the particular species other than reported historic occurrences. It is beyond the scope of this study to provide species accounts for all of the birds which are reported to breed within the study area. General information on occurrences of similar groups of birds, however, is presented as follows.

A. ***Ducks, Geese and Swans***

The Atlantic Flyway is one of the four major north-south avian migration routes within the United States. The Atlantic coastline and in particular, the Babylon study area, is situated directly within this path. As part of a federal effort to monitor waterfowl populations within the Atlantic Flyway, NYSDEC conducts an annual midwinter aerial survey of waterfowl occupying the Long Island coastline. Data collected by NYSDEC during the first week of January for the past eleven years (1981 through 1991) indicate the presence of 12 different ducks and geese within the bay waters of Fire Island Inlet and South Oyster Bay, including: American Coot, Mallard, Black Duck, Mute Swan, Merganser, Scaup, Goldeneye, Bufflehead, Oldsquaw, Canada Goose, Brant, and Ruddy Duck. Survey results show that the study area serves as a significant wintering ground for Black Ducks and Brant, which were consistently found each winter. The local population of Brant represents 12 percent of the 10-year, statewide survey average; and local Black Ducks represent 3 percent of the 10-year statewide survey average (Phillips, NYSDEC, October 16, 1992).

B. ***Colonial Waterbirds***

The Seatuck Research Program of the Cornell Laboratory of Ornithology, in cooperation with NYSDEC, began monitoring breeding populations of Least Tern and Piping Plover on Long Island in 1983. Since then, the nesting survey has expanded to include all colonial nesting terns, gulls, Black Skimmers, wading birds, cormorants, and American Oystercatchers. Least Terns and Piping Plover colonies are surveyed at least twice during the breeding season, while all other colonies are surveyed at least once. Information is recorded for each colony location including the type of species nesting, the number of active nests, the estimated number of breeding pairs, and the stage of nesting and development of the young. Additional information is recorded with respect to the actual or potential degree of colony disturbance by flooding, predation, pets, vandalism, vehicles, recreation, habitation, industry or other sources.

Based upon the latest published survey results, there were 14 colony locations on the Jones Beach barrier and bay islands within the study area (Downer, R.H. and C.E. Liebelt, March 1990). These include (listed from west to east): West Gilgo Beach (ocean shorefront), Gilgo Island, Gilgo State Park, Elder Island, east of Gilgo Beach, West Fox Creek, west of Cedar Beach, Cedar Beach, island northwest of Nezarus Island, Nezarus Island, Overlook Beach, the Sore Thumb, Grass Island, and Seganus Thatch Island. According to the Town of Babylon Department of Environmental Control (TOBDEC), an additional colony was identified on Little Island during 1992 surveys (Zitani, September 17, 1992).

During the data collection process for this study, CA plotted the colonial nesting locations on USGS quadrangle maps (to protect the viability of these habitats, these locations are not disclosed as part of this public document); and found that certain patterns of distribution began to emerge. This information was discussed with NYSDEC, and will be summarized in general terms. Although there were no recorded colonial nesting locations within 500 feet of the subject communities, all of the nesting locations (except for one common tern colony) lie within one-half mile of the residential areas or town park facilities. This is not intended to imply that the developed areas have no impact on these species. Rather, the nesting locations chosen by colonial waterbirds appear to be somewhat independent of the proximity to residential communities and park facilities. Since these species are waterbirds, it is likely that their choice of prime breeding locations is linked more closely to their available food supply, and adequate roosting and nesting vegetation or substrate. All of the historic and recently active colony locations occur between 200 to 500 feet from the shoreline, bordering boat channels, tidal creeks or the ocean.

Population trends for particular colony locations cannot be deduced at this time because of the lack of historical data (in many cases less than ten years of record has been compiled), and the tendency for some colonial species to shift nesting locations from one year to the next. However, general trends in breeding occurrences across Long Island for a particular species can be extracted. Breeding populations of wading birds have been found to be generally stable, including such species as Green Herons, Snowy Egrets, Great Egrets, and Glossy Ibis. The same is true for Great Black-Backed Gulls, Herring Gulls, Laughing Gulls, Common Terns and Roseate Terns. There has been a slight increase in nesting Tricolored Herons, Black Skimmers and American Oystercatchers, and there has been a general decline in Yellow-Crowned Night Herons and Cattle Egrets.

The primary impacts to colonial waterbirds include: the loss of habitat due to coastal development; recreational use (both pedestrian and vehicular) in close proximity to breeding and nesting territories; improper timing of dredging activities to avoid critical stages of breeding, nesting and fledging of young or placement of unsuitable dredged substrate material on or near historical nesting sites; and increased predation by domestic or feral animals and other natural predators which are attracted to areas of human activity.

C. *Raptors And Songbirds*

Table 5-7 lists the raptorial birds and songbirds which reportedly breed within the study area. In addition to the summer breeding populations, significant concentrations of raptors and songbirds travel through the study area during fall migration, which occurs generally between the last week of August through the first week of November (Great South Bay Audubon, November-December 1992). Numerous transient species which do not currently breed or over-winter within the study area pass through at this time, including: Osprey, Sharp-shinned hawk, Cooper's Hawk, Peregrine Falcon, Bald Eagle, Broad-winged hawk, and various warblers, loons and thrushes. CA observed this migration during field investigations, and also noted the relatively high number of avian mortalities which occurred due to collisions with vehicles on Ocean Parkway, homes, and other coastal structures.

As discussed for the Northern Harrier in Section 5.2.1, the primary impacts on raptorial birds within the study area include the loss of critical habitat, the increase in human disturbances (which may ultimately result in nest failure) and increased predation due to pets and wildlife associated with residential developments (ie, cats, dogs, raccoons, and opossums). The impacts on songbirds are somewhat different, however. Certain species of songbirds (and some waterbirds) exploit artificial provisions of food supplies at bird feeders, garbage dumpsters, docks, bait shops and boat-side disposal of fish scraps. Songbirds which typically benefit from these developments include: Blue Jay, Wrens, Downy Woodpecker, Song Sparrow, House Sparrow, Purple Finch, Mourning Dove, Cardinal, Mockingbird, Crows, Northern Oriole, Grackles, Pigeons (Rock Dove), Junco, Chickadees, Nuthatch, Tufted Titmouse, Starling and Hummingbirds. Other species of birds suffer from the loss of uninterrupted, undisturbed native vegetative cover, as well as increased human and pet disturbance. These species include: Cuckoo, Bobwhite, Brown Creeper, Brown Thrasher, Bluebird, Meadowlark, Grasshopper Sparrow, Owls, Thrushes and various Warblers.

5.2.3 FINFISH

A. *Species Occurrences*

The bay waters within and adjacent to the study area are important spawning grounds and nursery beds for at least 29 species of finfish, according to a study conducted by the Marine Sciences Research Center (MSRC) in Stony Brook (Monteleone, 1992). More than 35 additional species of finfish reportedly occupy the Great South Bay sometime during their adult life (R. Schreiber, May 23, 1973 and P. Briggs and J. O'Connor, January 1971). Table 5-8 provides a species list of the finfish taken from the Great South Bay as eggs, larval fish or adults.

Sampling for the MSRC juvenile fish study was conducted from April 1985 through December 1986. Table 5-8 indicates the growth stage of the finfish collected (eggs or larval fish) and the season of occurrence.

For the purposes of this document, only two seasons are distinguished: "in-season" indicates that juvenile finfish were found in samples taken between late May (Memorial Day) and early September (Labor Day); and "out-of-season" indicates occurrences other than these dates, between early September through late May. The MSRC study found that Bay Anchovy was the most abundant species comprising over 95 percent of the eggs and over 69 percent of the larval fish collected. Bay Anchovy spawns throughout the bay from late May through August. Other relatively abundant species include Windowpane Flounder, Blackfish, Atlantic Mackerel, Cunner, Winter Flounder, American Sand Lance, Atlantic Silversides and Northern Puffer.

Peak periods of juvenile fish abundance were identified by the MSRC (Monteleone, 1992). Peak production of fish eggs occurred during the late spring-early summer. This strongly correlates to the spawning period of the Bay Anchovy when water temperature exceeds 59 degrees Fahrenheit (°F). In addition, two major peaks in larval fish densities were found to occur: during March and April when Winter Flounder and American Sand Lance predominate; and during late spring early summer when Bay Anchovy predominate. The MSRC study also indicates that spring peaks in fish spawning activity tend to correlate with phytoplankton blooms and peaks in copepod densities (a type of zooplankton that is a primary food source for larval fish).

Accounts of adult finfish abundance in Great South Bay were based on sampling conducted by the MSRC from June through August 1972 (Schreiber, 1973) and sampling conducted by NYSDEC from mid-May to mid-October in 1967 and May 1st to mid-November in 1968 (P. Briggs and J. O'Connor, January 1971). According to the NYSDEC study, the Atlantic Silversides, Fourspine Stickleback, Striped Killifish and Mummichog were the most numerous species found in catches. The NYSDEC study primarily sampled bay waters in close proximity to the northern side of Cedar Island, Grass Island and Captree Island, in contrast to the MSRC juvenile finfish study which sampled open waters throughout Great South Bay. The purpose of the NYSDEC study was to compare the finfish species which frequented naturally vegetated underwater bay areas as opposed to sand-filled bottom areas created by the deposition of dredge spoil. NYSDEC found that seventeen species of finfish showed a preference for natural bottom sediments consisting of a mixture of sand, clay, mud, and detritus, including: Fourspine Stickleback, Mummichog, Northern Pipefish, Atlantic Needlefish, Threespine Stickleback, Winter Flounder, Silver Perch, American Eel, Rainwater Killifish, Blackfish, Cunner, Atlantic Herring, Bay Anchovy, Pollock, Blueback Herring and Atlantic Tomcod. Six species showed a preference for the sandy, dredge-fill bottom areas, including: Striped Mullet, Striped Killifish, Sheepshead Minnow, Atlantic Silversides, White Mullet and Northern Kingfish. Among the abundant species NYSDEC collected, only four showed no clear preference for any bottom type, including: Northern Puffer, Tidewater Silversides, Bluefish and Atlantic Menhaden.

B. ***Impacts to Finfish***

Only general conclusions can be reached about the impacts of the coastal communities on the finfish which occupy the waters of the study area, without an in-depth review of each species' biology. Based upon the location and type of disturbance, and time or season of occurrence, each species will be affected differently. The NYSDEC study found that the least populated waters were generally those composed of pure sand, due to the lack of food and protective cover. Therefore, the indiscriminate deposition of sandy dredge spoil will have a negative impact on the abundance of bait, forage and sport fishes. The greatest diversity and abundance of finfish were found to occur within the vegetated nearshore areas. Eel grass (Zostera marina) is the dominant underwater plant growing in the nearshore areas or tidal shoals and mudflat zone (SM), as described in Section 5.1.1 (C. Jones and J. Schubel, September 1980). In a study conducted on eel grass by Adelphi University, it was noted that historic declines in eel grass were paralleled by a depletion or disappearance of a wide variety of waterfowl, shellfish and finfish (R. Wilson and A.H. Brenowitz, 1966).

Disturbances of a seasonal nature, such as increases in boat traffic and human intervention during the summer months, have a greater potential to impact those finfish species which are known to spawn in the study area waters from May through September. Finfish survival and productivity is inextricably linked to water quality. Any activities undertaken or caused by community residents which either directly or indirectly result in the degradation of surface water quality will produce a negative impact on the finfish resources.

C. ***Regulatory Controls***

Town of Babylon has enacted some regulations which manage finfish and control catches. Chapter 86 of the Town Codes prohibits trawling and net fishing in Great South Bay and Fire Island Inlet. Sections 17 and 18 of this code help to maintain surface water quality by prohibiting the discharge of oil, chemicals, cesspool wastes, garbage, rubbish, and toilets into surface waters (as discussed in Section 5.5.3).

NYSDEC has set an open season for Fluke (May 15th through September 30th), and minimum size and possession limits for several species of finfish found in the study waters. These are summarized as follows (NYSDEC, effective January 1, 1992):

SPECIES	MINIMUM COMMERCIAL SIZE	MINIMUM RECREATIONAL SIZE	RECREATIONAL POSSESSION LIMITS
Fluke	14 inches	14 inches	6
Weakfish	16 inches	16 inches	6
Winter Flounder	11 inches	10 inches	any number
Blackfish	12 inches	11 inches	any number
Pollack	19 inches	19 inches	any number
Bluefish	9 inches	any size	10
Porgy	7 inches	any size	any number
Mackerel	7 inches	any size	any number
Black Seabass	8 inches	any size	any number

5.2.4 SHELLFISH AND CRUSTACEANS

A. *Species Occurrences, General Biology and Harvesting*

The marine waters in the study area support a variety of shellfish and crustaceans. These are important not only as natural resources, but also for their contribution to the Town's recreational and commercial fishing opportunities. Over 20 species of shellfish and 8 species of crustaceans were reported as occurring within the study waters of the Great South Bay, according to a study conducted under a grant from the U.S. Environmental Protection Agency (Greene, 1978). Samples were taken from 17 locations within the study area in close proximity to the developed areas. Sampling was conducted from June through November in 1978 using commercial clamming tongs and a suction dredge. A map depicting the sampling locations and data collected are included in Appendix D. The species collected are listed in Table 5-9. Review of the EPA data indicates that the Amethyst Gem Clam was the most abundant species (over 2,000 individuals) collected by the dredge followed in much lower quantities by the Thick-Lipped Oyster Drill (197), Northern Dwarf Tellin (120) and Common Awning Clam (112). The Hard-Shelled Clam was the most abundant (over 550) and widely distributed species recovered using clamming tongs, followed by the Thick-Lipped Oyster Drill (126), Common Awning Clam (78), and Atlantic Oyster Drill (48).

The edible shellfish and crustaceans found within the waters of the study area include: hard-shelled clams or quahogs (Mercenaria mercenaria), soft-shelled clams or steamers (Mya arenaria), oysters (Crassostrea virginica), bay scallops (Aequipecton irradians), blue mussels (Mytilis edulis), conches (Busycon sp.) blue-claw crabs (Callinectes sapidus), and lobsters (Homarus americanus).

The Hard-Shelled Clam is the most economically important shellfish harvested from the study waters. On the average, landings of Hard-Shelled clams in the Town of Babylon gross an estimated 1.5 million dollars annually. This value is based upon NYSDEC records of total recorded landings for the past 25 years (which are typically conservative due to unreported catches) and Town estimated dollar values. The Town has recently (1985, 1991) conducted surveys of the Hard-Shelled Clam resources in the Great South Bay. This information has been compiled and included in Appendix D.

The hard-shelled clam is found generally near the top of sandy or muddy sand substrates in bays and along ocean beaches (Gosner, 1978). Hard clam spawning on Long Island typically takes place from May through September. It takes approximately three years for a hard clam to reach harvestable size of one inch. Hard clams are marketed in three general size categories based on shell size. Littlenecks are the smallest, and have the highest dockside value because the small clams are the most tender when eaten raw on the half-shell. Cherrystones are intermediate in size, and chowders are the largest. Hard clams eventually reach an old age period during which growth is slow and interrupted. Old age is usually reached in six to ten years depending on environmental conditions (SCDHS, unpublished Draft Brown Tide Study).

Chapter 183 of the Town Codes regulates the harvesting of hard-shelled clams and other shellfish from Town waters. A brief overview of this regulation is contained in Section 5.5.3. According to this ordinance, no more than three percent of each bushel or container of hard-shelled clams taken, sold or possessed within the Town shall contain clams less than one inch in thickness.

The TOBDEC has been conducting an aquaculture program within the waters of the study area for the past 15 years. Hard-shelled clam seed (approximately 3 to 5 millimeters in length) is placed on 44 floating racks in the Cedar Beach Marina. The clams are grown to approximately 20 mm (a size which is less susceptible to predation) and then scattered throughout the central portions of Great South Bay from areas north of Cedar Island to north of Grass Island. The Town raises over one million clams per year through this program. The seed clams, which are purchased out-of-state, are a genetic variant to those found naturally in the study area waters, and can be distinguished by the presence of red streaks in their shells. Recovery of these red variants within the state boat channel indicates that the Cedar Beach Marina has also developed as a spawning bed for clams that have begun to disperse naturally (Litwa and Zitani, TOBDEC, December 9, 1992).

In contrast to hard-shelled clams, soft-shelled clams are generally found buried in muddy bottom sediments in bay areas. Mature soft-shelled clams reach an average size of 3 to 4 inches, and on rare occasions to 6 inches (Gosner, 1978). Chapter 183 of the Town Codes prohibits the taking of soft-shelled clams less than 1.5 inches in size.

American oysters live in waters with a fairly restricted salinity range (from 5 to 30 parts per thousand) and cannot tolerate prolonged exposure to fresh water or the high salinities typical of marine waters. Therefore, oysters are typically found in bays, estuaries and tidal creeks with the proper salinity characteristics and a hard substrate for attachment (Gosner, 1978). Chapter 183 of the Town Code permits the harvesting of Oysters from certified town waters from September 1 through May 14, at a size no smaller than 5 inches (as determined by adding the length to the width).

As their name implies, Bay Scallops are typically found on bay bottoms in the nearshore areas to depths of about 50 feet (Gosner, 1978). Bay scallops have a short life span of 18 to 22 months and adults generally spawn only once in their lifetime, from late spring through summer. Long Island bay scallops typically experience a mass mortality during the mid-winter of their second year. Although the adults are mobile, young scallops primarily remain attached to beds of eelgrass or bottom substrates (SCDHS, unpublished Draft Brown Tide Study). Scallops may be harvested from certified Town waters only between October 15th through April 1st. The Town's limit is 10 bushels per day for one person and 20 bushels per day per boat, for two or more people occupying the same boat.

Blue Mussels are fairly widespread, occupying slightly brackish estuaries to marine waters several hundred feet offshore. Blue mussels attach themselves to intertidal rocks, pilings, scattered shells and other mussels using tenacious byssal threads, often forming large reefs even on muddy tidal flats (Gosner, 1978). The Town's shellfish regulations do not specify any limit on the size, quantity, or season for the taking of Blue Mussels.

Conches are commonly found in shallow waters along bay and ocean beaches where the salinity reaches higher than 20 parts per thousand. Conches are carnivorous sea snails which prey upon bivalves, such as oysters and clams (Gosner, 1978). Recognizing that conches can threaten populations of more valuable shellfish resources, the Town requires that all conches caught during shellfish harvests be taken or not returned alive to Town waters. The Town code further stipulates that starfish, oyster drills and periwinkles must also be retained with shellfish catches.

Blue-claw Crabs are commonly found in the moderately shallow brackish waters of estuaries, tidal creeks and canals, but migrate to deeper offshore areas in the winter to breed. Males are typically found in the fresh and brackish portions and females in the saline portions of the bay system. Lobsters may be found in the bay and ocean waters of the study area, but they typically congregate in areas with rocky bottom substrates. Newly hatched lobsters are planktonic, and will not settle to bottom dwelling until about one inch in length. Young lobsters (under one foot in length) may dwell within 10 to 15 feet of the shore in winter, but large mature lobsters occupy deeper waters (Gosner, 1978). The Town codes do not set any restrictions on the size, number or method of harvesting Blue-claw Crabs or Lobsters. However, NYSDEC does regulate the taking of these two species, pursuant to the Environmental Conservation Laws of New York State. Female Blue-claw crabs may not be taken if laden with eggs, and a state permit is required for landing more than 50 Blue-claw Crabs in one day. NYSDEC has set the minimum legal size limit for lobsters at 3.25 inches in carapace length (the hard shell on the back of the lobster). In addition, lobsters with eggs cannot be taken (NYSDEC, January 3, 1993).

B. ***Shellfish Harvesting Waters***

NYSDEC has designated the waters of Great South Bay from the Nassau/Suffolk line to Robert Moses Causeway as a shellfish growing area. NYSDEC routinely monitors the water quality in conjunction with TOBDEC, as part of the Food and Drug Administration's (FDA) National Shellfish Sanitation Program. In addition, NYSDEC collects information on potential pollution sources such as storm drainage outfalls, discharges from sanitary sewers, septic systems or wastewater treatment plants, pollutants associated with adjacent land uses, etc. NYSDEC has collected and analyzed sufficient data within the study area to classify the shellfish harvesting waters into one of three categories as follows:

- Certified - Approved for the taking of shellfish. Waters open year-round.

- Uncertified - Closed for the taking of shellfish.

- Seasonally certified - This designation covers areas that have seasonal sources of pollution such as marinas and mooring areas. These areas are typically closed during the summer months and reopened during the winter.

The water quality data which support the NYSDEC classifications are contained in Appendix B and discussed in Section 2.4. NYSDEC has classified the northern third of Great South Bay as uncertified, as depicted in Figure 5-1. Waters within the Cedar Beach Marina, Gilgo Beach Marina, Coast Guard Cove, Hemlock Cove, and marina boat basins at West Gilgo and Seganus Thatch are classified by NYSDEC as seasonally uncertified, and closed to shellfish harvesting between May 15th through September 30th. The remaining waters within the study area are certified and open to shellfish harvesting year-round, according to NYSDEC classifications.

The Town retains the right to impose additional restrictions on shellfish harvesting, pursuant to Chapter 183 of the Town Codes regulating shellfish. Section 183-17 of this code stipulates that the Town Board may designate under water town lands as management areas. The Town has designated the West Gilgo Beach Lagoon, the Cedar Beach Marina, and the waters surrounding Oak Island to the north, east and south as management areas. Cedar Beach Marina is closed year-round to both commercial and recreational shell-fishing, due primarily to the fact that this is the growing area for the Town's seed clam program. The West Gilgo Lagoon, and the waters surrounding Oak Island are closed to commercial shell-fishermen, with one exception; the waters south of Oak Island known locally as the "Lead" are opened to commercial shellfishing in January and February. The waters of West Gilgo Lagoon are opened year-round for recreational shellfishing by Town residents at large who possess personal shellfishing permits. However, the waters surrounding Oak Island to the north and east, eastward to the Robert Moses Causeway, are closed to all except the residents of Oak Island who possess personal shellfishing permits. This exemption to the closure of the Oak Island Management Area is contained in Sections 183-22 and 183-23 of the Town Codes. These sections effectively exclude Town residents at-large and commercial shellfishermen from waters otherwise deemed suitable by the state for shellfish harvesting.

5.2.5 MAMMALS AND FERAL ANIMALS

A. *Native Mammals*

When compared with the diversity and number of bird species occupying the study area, the diversity of mammals is comparatively small. Table 5-9 lists the mammals which have been observed during CA's field investigations, or are expected to utilize the area based on the habitat types available.

Gray squirrels were observed within the residential areas of Oak Beach and Gilgo West, and are expected to occupy all of the communities within the study area. Based on the number and frequency of tracks found, CA expects that Oak Island supports a relatively large population of Raccoons. Although none were seen during CA's field surveys, Chipmunks, House Mice, Norway Rats and Opossums are expected to occupy the developed areas. Norway Rats may also be found scavenging among the stone jetties and groins at Oak Beach (Connor, 1971). (Due to the fact that they are typically introduced by and dispersed through developing areas, Norway Rats and House Mice are not generally thought of as native to the study area).

Red Fox tracks were found along the sandy shoreline in the vicinity of the Robert Moses Causeway (east of the Oak Beach Association) and within the backdune areas of Cedar Beach. Tracks of Meadow Jumping Mouse were also found on the sandy patches between clumps of beachgrass in the backdune areas. White-tail Deer tracks were found throughout the backdune and freshwater wetland areas east of the Oak Beach Association, along with droppings from Eastern Cottontails. Cottontails are expected to occupy the entire barrier beach land mass, since many have been seen along Ocean Parkway in the vicinity of Jones Beach during the summer months. In addition, Woodchucks are expected to utilize the grassy right-of-ways bordering Ocean Parkway. A Meadow Vole was found within the mixed grassland/shrub upland habitat bordering tidal marshes on the north side of the barrier. As discussed in Section 5.2.1, Meadow Voles (Microtus sp.) are the primary food source for the local population of Northern Harriers.

Although none were observed during CA's field investigations, several other mammals are expected to utilize the study area. Muskrats, Longtail Weasels and Eastern Moles are expected along the freshwater and tidal marsh fringes. Masked Shrews and White-footed Mice are expected within the grassy uplands and backdune areas along with Meadow Voles.

Pine Voles are expected within the upland shrub thickets and linear Japanese Black Pine stands along the Jones Beach barrier.

B. ***Feral Mammals***

Readily apparent within the communities and throughout the adjacent natural areas is the presence of domestic cats; many of which are suspect to have been born and surviving in the wild as feral animals. Although a census was not actually taken, the greatest density appeared to occupy the eastern portion of the study area, including Captree Island, Oak Island, and Oak Beach. Cats were viewed along tidal marsh fringes, and numerous tracks were found along backdune areas bordering Ocean Parkway. Local residents claim that it is common practice for motorists visiting the neighboring beach areas to dump off cats at the end of the summer. Feral dogs are also suspected to be present, although none were actually found during field inspections.

Feral dogs and cats can have a significant impact on wildlife using the study area. Feral animals will rely on food scraps tossed out with household garbage causing frequent human confrontations with Raccoons. In addition, feral animals will search for alternate food supplies and eventually compete with other natural predators for the same prey species. Disturbances by feral animals to ground nesting birds can also have serious consequences. As discussed in Sections 5.2.1 and 5.2.2, young Piping Plovers and terns are particularly vulnerable to predators until they are fledged (capable of flying). Frequent attempts to attack birds nesting at the outer edge of colonies place Roseate Terns in the highest risk, and may drive nesting birds out of the area altogether. Some of the species may not attempt to re-nest after being disturbed, while others, even though successful at hatching new young, the young may not reach maturity in time to survive migration.

This discussion, while it stresses the potential impacts of feral animals, is not meant to exclude the impacts that other natural predators have on endangered, threatened and protected bird species attempting to nest in the study area. The problem is compounded however, when the numbers of these natural predators rise due to their ability to adapt or exploit an urbanizing environment. Town officials have noted an increasing trend in the number of Raccoons, Crows and Black-backed Gulls, in addition to dogs and cats, harassing colonial-nesting shorebirds over the past four years (Hanse, T.O.B., November 4, 1992).

5.3 VARIATIONS TO THE NATIVE VEGETATIVE COMMUNITIES

5.3.1 HISTORICAL PERSPECTIVE

The Jones Beach barrier and bay islands underwent extensive changes around the turn of the century and up until the 1950's under the direction of Robert Moses and the Long Island State Park Commission

(LISPC). Prior to this, access was limited and these areas were frequented only by Oyster Companies for aquaculture programs and farmers who cut salt hay (Spartina sp. and Distichlis spicata) from the tidal marshes. The Town began leasing lands for residential purposes around the 1870's, as is discussed in further detail in Section 6.1.

During the course of this study, CA viewed historical photos in the archives of the LISPC and the Long Island Regional Planning Board (LIRPB). According to the LIRPB photos, dredging was conducted during the 1930's to produce fill material to accommodate the relocation of homes from High Hill to West Gilgo Beach. A 1933 LISPC photo taken from the now defunct Coast Guard Station at Gilgo Beach showed 21 homes comprising the Gilgo Beach East community. No homes were present at Gilgo Beach West; rather, this area appeared as vegetated tidal marsh, with bay waters at a much closer proximity to Ocean Parkway than it appears today. Fill material was placed on top of tidal wetlands and adjacent areas during the course of residential development. At the time, this practice was common not only within the barrier and bay island communities, but also along the entire south shore of the Long Island mainland. The loss of tidal wetlands that was permitted during this period was highly significant, in comparison to the minimal changes that could occur today under current state and town regulations.

Other significant historical changes include: the dredging and filling activities associated with the construction of Ocean Parkway and the creation of the State Boat Channel from the 1930's through the 1950's; the associated filling of the entire Cedar Island Inlet (formerly located slightly west of the Sore Thumb); and the fragmentation of several bay islands (including Cedar Island, Seganus Thatch and Captree Island) due to the creation of the State Boat Channel and construction of Robert Moses Causeway. Mosquito ditches were dug in the tidal wetlands sometime between the 1930's to 1960's. LISPC photographs indicate that extensive areas both north and south of Ocean Parkway were planted in the 1930's with Beachgrass (Ammophila sp.) plugs. In addition, Beachgrass plugs were commonly planted to stabilize shorefront properties after the placement of dredge spoil, as viewed in a series of photos taken in 1946 at Oak Beach. It is interesting to note that no Common Reed (Phragmites communis) or Japanese Black Pine (Pinus thunbergii) appear in these earlier photos. These species begin to appear in the 1960 photos, occupying the roadway right-of-way and other filled areas.

In 1980, the U.S. Army Corps of Engineers contracted Topo-Metrics, Inc. to conduct a detailed vegetative survey of the Long Island barrier beaches. This survey covered the portion of the study area occurring generally south of Ocean Parkway from Cedar Beach in the west to Robert Moses Causeway in the east. Most of the vegetative coverage shown on these maps has not changed over the past twelve years. This survey information has been delivered to the TOB Department of Environmental Control for their file records.

Much of the "native" vegetation which occupies the communities and recreational facilities today, were in fact introduced by transplanting efforts of the LISPC and community residents during the 1930's through 1960's. Many of these planted species have produced a beneficial impact (such as the Beachgrass plugs, Beach Pea, Virginia Creeper and Bayberry) in terms of stabilizing dunes and shorefront areas; whereas others (such as the Japanese Black Pine) have introduced pests and disease problems. These issues are discussed further in Sections 5.1.4, 5.3.2 and 5.3.3.

5.3.2 ENCROACHMENT OF ORNAMENTAL PLANTS INTO SURROUNDING VEGETATIVE COMMUNITIES

As discussed earlier, the residential communities within the study area have historically been developed on top of filled wetlands, uplands and dune areas. The impacts to each type of native vegetative cover have been discussed separately in Sections 5.1.1 through 5.1.4. The impact of replacing native vegetation with ornamental landscape plants within the community areas takes on a greater significance if these introduced plant materials have the ability to spread to outlying natural areas and successfully outcompete the vegetation in their native habitats.

CA compiled a list of the plant materials found growing in the barrier and bay island communities of the study area. The native species are denoted in Table 5-5, while the remainder are considered ornamentals or introduced plants. The introduced species which have the potential to propagate readily and invade the surrounding habitats have been designated by an asterisk. These include species that produce seeds which are easily dispersed by wind or birds and typically germinate in sandy soil conditions, or which easily root from pruned pieces of branches or other plant parts. Although certain landscape plants included on this list propagate naturally by runners or underground stems in loamy garden soils, they do not grow as easily in the native sandy soils exposed to extremes in moisture and temperature conditions. These are not, therefore, expected to disperse as readily.

As discussed in Sections 5.3.1 and 6.1, the communities in the study area were first developed in the late 1800's and early 1900's. The landscaping within these communities is well established and patterns in cover types are not expected to change drastically in the future, barring major storm events. The extent of urban vegetation has remained relatively confined to the developed communities, as depicted in Plates 2A through 2G. Only a few species have apparently dispersed successfully, although their spread is still fairly local to the developed areas. Japanese black pine seedlings have been found within the dunes and upland areas surrounding the communities. Japanese black pines have experienced the greatest extent of dispersal. This may in part be due to the relative abundance of this plant in contrast to other ornamental species. Even though other introduced species may be present in fairly high numbers, the large spacing between individuals of the same species may inhibit seed production. Oriental bittersweet appeared second in abundance in the outlying areas. Although bittersweet vines were found within every community, they have taken a stronghold in the communities of Oak Beach Association, Oak Beach and Oak Island. However, bittersweet was found to be confined to the roadsides, uplands and woodland areas. Bittersweet did not appear to encroach into the dune areas located west of Oak Beach or east of Oak Beach Association. The only other introduced species which CA found to be mildly dispersed is weeping lovegrass. Weeping lovegrass is not native to Long Island, but it is fairly well adapted to dry, sandy soils, and is used frequently in highway stabilization plantings. Sparse patches of weeping lovegrass were found bordering development roadways in Oak Beach and Oak Beach Association.

Many of the shrub and groundcover species which are native to the Jones Beach barrier can be readily found in local nurseries. The ecology of the coastal communities would benefit from the replacement of typically ornamental species by native species in residential landscaping. This is discussed further in the mitigation Section 5.6.3.

5.3.3 PINE WILT DISEASE

Japanese Black Pine (Pinus thunbergii) is an ornamental species introduced from Japan and Korea. Japanese Black Pines were widely planted along Ocean Parkway and the Robert Moses Causeway by the Long Island State Park Commission and New York State Department of Transportation from the 1960's until fairly recently. This plant was highly utilized in landscape plantings because of its salt spray tolerance and ability to thrive in very sandy, exposed locations.

However, since the late 1970's, the Cornell Cooperative Extension and Long Island Horticultural Research Laboratory have been monitoring the decline of the Japanese Black Pines (and other native Pitch Pines) across Long Island due to Pine Wilt Disease. Pine Wilt Disease is primarily caused by two different insect vector/pathogen life cycles: The Black Turpentine Beetle (Dendroctonus terebrans) in association with a Blue-stain Fungus (Leptographium spp.); and a combined attack from the Pine Sawyer Beetle (Monochamus carolinensis) and the Pinewood Nematode (Bursaphelenchus xylophilus). Trees 15-20 years of age growing in the harshest seashore locations are the most susceptible (Daughtrey and Kowalsick, 1988).

Black Turpentine Beetles generally bore into the lower 4 to 5 feet of the trunk or below the soil level. Resin produced by the affected tree flows through this hole, drips and hardens producing a characteristic "pitch tube". The beetle larvae which feed on the inner bark, may completely girdle the tree eventually causing its death. Black Turpentine beetles often carry a Blue-stain fungus to the inner wood of the tree, where the fungus attacks the cambium layer and accelerates the decline of the tree. Outward symptoms of this attack include the presence of pitch tubes and an overall color change of the needles from a healthy dark green to lighter pale green and eventually to brown (Daughtrey and Kowalsick, 1988).

Pine Sawyer Beetles which feed on the upper succulent growing branch tips of the Japanese Black Pine often introduce the microscopic Pinewood Nematodes. These nematodes multiply and feed within the resin canals of the pine tree. Within three to four weeks of infection, the buildup of this parasitic nematode in the branch causes the needles to pale, then turn yellow. Within five to six weeks the entire branch dies. The literature is unclear as to the time of spread to other unaffected portions of the tree, except that it is believed to be fairly rapid. Needles on the dead tree turn rust colored but do not fall off. Pine Sawyer Beetles are attracted to stressed or dying Japanese Black Pine trees to lay their eggs. The larvae burrow under the bark and invade the deeper layers of the wood. After two years, adult beetles bore out of the tree, often highly contaminated with the Pinewood Nematodes and fly on to healthy trees, continuing the Pine Wilt disease cycle (Daughtrey and Kowalsick, 1988).

Unfortunately, by the time Japanese Black Pines show any symptoms of Pine Wilt, the pest cycle has progressed too far to save individual trees. Control of the vector insects by insecticides is not presently recommended or deemed practical, due to the fact that the flight range of the vector beetles is unknown, but is believed to be considerable. The best current method for controlling the spread of the disease is improved sanitation, including prompt removal and burning of all affected or dead trees. Preventive measures including deep irrigation during periods of prolonged hot, dry weather and routine fertilization, will help maintain Japanese Black Pine trees in good health (Daughtrey and Kowalsick, 1988).

Research conducted in Japan by the Forestry and Forest Products Research Institute (1983) and by the U.S.D.A. Forest Service (1982) indicated that several other pine species are susceptible to Pine Wilt disease, including (but not limited to):

Scots Pine	*Pinus sylvestris*
Mugho Pine	*Pinus mugo*
Eastern White Pine	*Pinus strobus*
Red Pine	*Pinus resinosa*
Ponderosa Pine	*Pinus ponderosa*
Black Pine	*Pinus nigra*
Slash Pine	*Pinus elliottii*
Korean Pine	*Pinus koraiensis*
Japanese Red Pine	*Pinus densiflora*
Austrian Pine	*Pinus nigra* var. *austriaca*

Preliminary research findings also indicate that different species of pines exhibited varying degrees of resistance to Pine Wilt, when subjected to inoculations of the parasitic nematodes at the seedling stage of growth. Pitch Pine (*Pinus rigida*), one of Long Island's native pines, Jeffrey Pine (*Pinus jeffreyi*) and Short-leaf Pine (*Pinus echinata*) are three species adaptable to this region which appear to be resistant. However, further research is needed on mature trees growing under natural conditions to draw any solid conclusions. The literature indicates that development of genetic variants to the Pine Wilt resistant species, which are being developed at the present time, may provide the most viable long-term alternative to landscaping with Japanese Black Pine (Dropkin and Linit, 1982; Mamiya, 1983).

5.3.4 MOSQUITO DITCHES

"Mosquito ditches" is the local name for the open surface drainage ditches which currently transect the wetlands of nearly every bay island within the study area. These ditches were excavated sometime between the early 1930's and 1960's, based on historic aerial photographs viewed by CA. Mosquito ditches are generally aligned in parallel rows, spaced approximately 150 to 200 feet apart. Their primary purpose is to improve the drainage of tidal flats and other wet areas in order to reduce the proliferation of mosquitos. Originally dug by hand, the mosquito ditches are currently maintained and cleaned out using low ground pressure rotary ditchers which excavate a shallow (approximately 18 inch deep) trench and distribute the spoil evenly on either side of the ditch (Venero and Sperry, SCBVC, November 10, 1992).

The practice of installing and maintaining mosquito ditches can ultimately alter the type and extent of wetlands within the study area. As discussed in Section 5.1.1, the clean-out of a series of surface ditches and replacement of an outlet pipe altered the hydrology of a freshwater wetland system in Oak Beach Association. This resulted in the transition of the lower portion of the freshwater wetland system into a tidal, high marsh (HM) type wetland. In this situation, a solid stand of common reed was gradually replaced at the central lower elevations by saltmeadow cordgrass and saltgrass, with a fringe of common reed remaining along the outer higher edges of the wetland. This change in hydrology had increased the vegetative diversity of this small wetland system. Common reed ranks fairly low in providing food and cover for wildlife, especially on such a small scale surrounded by residential development. By improving the drainage and increasing the vegetative diversity, this wetland was upgraded to a potentially more productive marsh.

The U.S. Fish and Wildlife Service currently supports open water marsh management programs (OWMMP's) as an alternative to maintaining mosquito ditches. An OWMMP typically entails conducting a ground survey to identify the lowest elevations in a marsh, and strategically placing culverts and digging channels to provide a direct connection between these isolated low spots and open tidal waters. Thus, OWMMP's offer several advantages over conventional mosquito control practices, including:

- increasing local salinity levels by improving tidal flows;
- this induces a shift in vegetative patterns from species typical of upland transitional zones to high marsh, and/or high marsh species to low marsh;
- reduces or eliminates the spread of common reed; and

- improves habitat conditions for larval estuarine fish which ultimately feed upon and help control mosquito populations.

When considered on a large scale, the routine maintenance of mosquito ditches or instituting OWMMP's may arrest the process of natural succession (whereby high marsh areas gradually revert to upland or fresh marsh areas, and low marsh areas transform to high marsh areas). Collectively considered, this will perpetuate the current extent of tidal marshes in the study area. Although uncertain as to the cause, it appears that there has been an overall expansion in intertidal marsh (IM) areas adjacent to the community areas which were formerly mapped as high marsh (HM) by NYSDEC in 1974. As discussed in Section 5.1.1, mosquito ditching and other mosquito control practices are conducted by the SCBVC on an as-need-basis. Community residents indirectly affect these impacts to the wetlands areas by placing requests and mosquito complaints with the SCBVC.

5.3.5 MOWING PRACTICES

Since at least 1974 (the date of the aerial-based NYSDEC tidal wetland maps), residents in West Gilgo Beach, East Gilgo, Oak Island and Captree Island have cleared or mowed common reed and tidal marsh grasses adjacent to homes, roadways and community recreation areas. Many of these areas lie within or are substantially contiguous to state mapped tidal wetlands. According to the State's tidal wetlands regulations (Article 25 of the ECL). the mowing of marsh grasses and cutting of tidal wetland vegetation is prohibited under the State's tidal wetland regulation, Article 25. Mowing and/or cutting tidal wetland vegetation is considered a "regulated activity"; and is defined in Section 661.4 (ee)(vi) of Article 25 as "any new activity within a tidal wetland or on an adjacent area which directly or indirectly may substantially alter or impair the natural condition or function of any tidal wetland." According to NYSDEC staff, close mowing of tidal marsh areas impairs the growth and vigor of low marsh and high marsh grasses, and provides a competitive advantage to (less desirable) fringes of Common Reed. Further-more, cutting tidal marsh vegetation encourages upland uses which are also otherwise prohibited by state regulations (Dubois, NYSDEC, December 30, 1992).

Conflict had recently arisen between residents of East Gilgo Beach and NYSDEC, where NYSDEC claimed residents had been cutting or mowing saltmeadow cordgrass (Spartina patens), common reed (Phragmites communis), groundsel-tree (Baccharis halimifolia) and other wetland shrubs without first obtaining a NYSDEC permit. Residents claimed that they needed to remove this material for fire protection purposes, to reduce mosquito and tick problems and to provide usable backyard areas on their leased lots. In an effort to reach a compromise, the Town of Babylon Department of Environmental Control discussed the situation with NYSDEC (Kluesener, T.O.B., October 9, 1992). NYSDEC staff produced a preliminary management proposal for protecting tidal wetland species on the Town's leased lots in East Gilgo. A copy is included in Appendix D of this report.

The Town and residents reviewed NYSDEC's proposal and determined that it would still impose a hardship and create a fire hazard. NYSDEC again met with Town officials and drafted a mutually agreeable policy. This policy is currently under review in the Town Attorney's office. In summary, the draft policy contains the following provisions:

- The September 23, 1992 aerial photographs taken as part of this study will serve as the baseline for future actions;
- Residents can continue to maintain a cleared area as shown in 1992 photographs without obtaining a NYSDEC permit;
- No resident can clear existing undisturbed wetland vegetation as shown in these photographs without first obtaining a NYSDEC permit;
- Residents cannot clear beyond their lot lines;
- Regardless of the preceding provisions, residents can clear within 15 feet of existing structures for fire prevention and control.

After the Town Attorney has given its approval, the Town Department of Environmental Control will submit the finalized policy to the Town Board for review and recommend that it be adopted as a model for all of the Town's coastal communities (Kluesener, November 25, 1992).

5.4 VARIATIONS IN WILDLIFE POPULATIONS

5.4.1 POPULATION SHIFTS IN RESPONSE TO CHANGING VEGETATIVE PATTERNS

The species of wildlife that are present on the barrier and bay islands will depend upon the particular mix of vegetation, the percentage of cover and the types of cover which occupy the study area. Changes in the vegetation will create shifts in both the variety and total number of wildlife species which utilize the area. A reduction in the total acreage of grassland/shrub thicket habitat will effect a decrease in the number of Meadow Voles, Cottontails, Shrews and Mice which occupy these areas. This in turn will affect predatory species, such as Fox, Weasel, Northern Harrier and other raptorial birds. A reduction in available prey species would initially cause predatory animals to hunt or forage elsewhere, creating territorial conflicts with neighboring similar species. Ultimately such conflicts may reduce the number of offspring produced, or result in a species leaving the study area altogether. This could have serious consequences for endangered or threatened species which currently breed within the study area.

Similar scenarios would occur as a result of significant losses in any of the other cover types described in Section 5.1. A reduction in underwater habitats vegetated with eel grass (<u>Zostera marina</u>) due to nearshore dredging operations or concentrated boating activity will potentially impact fisheries and waterfowl. A study conducted by Adelphi University states that up to one-third of the total species present in eel grass communities may disappear as a result of a deterioration in this ecosystem. Canada Geese, Brant, Black Ducks, Scaup, Redhead and other waterfowl, Shrimp, Bay Scallops and several finfish species would be directly affected (R. Wilson and A. Brenowitz, July 1966).

The replacement of an existing vegetative cover type with another will create a shift in the types of wildlife species utilizing an area. This is particularly the case in residential developments, as described in Sections 5.1.5, 5.2.2, and 5.3.2. The process of community development typically fragments otherwise uninterrupted areas of native vegetation, and thus creates numerous "edge" type habitats. This does not represent a significant impact for the study area, because the majority of the coastal landscape already consists of grassland/shrub thicket habitat or wetland/shrub interfaces. However, the replacement of native vegetation with ornamental species in the residential areas, coupled with the increase in human (and pets/feral animal) interaction creates a moderate impact on wildlife species.

The ornamental species which replace native plants in a community are often less valuable in terms of providing food and cover for the resident wildlife species. Native bayberries and beach plums provide food for over 25 species of resident and migratory songbirds, as well as nesting cover, and also provide browse for deer and fox. Blueberries and the various native sumacs provide food and cover for over 20 species of songbirds, and the foliage and twigs are favored by cottontails, deer, fox, opossum, and mice (Martin, Zim and Nelson, 1961). These are just a few of the native shrub species found growing on the Jones Beach barrier. In contrast, many ornamental species have been genetically selected against fruit production to minimize the required maintenance. Although ornamental species (particularly evergreens) offer cover for wildlife, they generally provide far less food resources (in terms of quantity, variety and palatability) to local wildlife populations.

The provision of artificial food supplies at bird feeders will benefit certain avian species which adapt well to urbanizing environments. However, this may attract Starlings, Blackbirds, Grackles and House Sparrows, which will compete with other more desirable avian species for limited breeding and nesting territories, and will result in an overall decrease in the diversity of the avian fauna.

The encroachment of ornamental landscape plants into the surrounding native plant communities has been limited in the study area, as discussed in Section 5.3.2. Japanese Black Pine and Oriental Bittersweet are the primary species which CA found in the outlying areas. Oriental Bittersweet (similar to its native relative-American Bittersweet) provides cover for nesting songbirds, berries which are eaten by Cottontail, Squirrel, Bobwhite, Pheasant and various songbirds, and browse for Deer and Cottontail (Northeastern Forest Experiment Station, 1974). The spread of Bittersweet, therefore, has had a relatively positive impact on wildlife species.

The introduction of Japanese Black Pine has produced mixed results. It currently represents the dominant plant in the tree canopy, and has provided valuable food and cover for various songbirds and small mammals. However, its recent decline due to the Pine Wilt Disease (as discussed in Section 5.3.3) has placed the Japanese Black Pine population in jeopardy, and serves as a disease bank or host for future outbreaks in yet unaffected areas. The ultimate loss of these mature trees from the coastal landscape will impact several species which are dependent upon this tree canopy for food reserves or nesting areas, such as Squirrels, Woodpeckers, various Warblers, etc. These wildlife species may leave the study area after the decline of the Japanese Black Pines or until other tree species re-colonize the area.

5.4.2 YEAR ROUND VERSUS SEASONAL DISTURBANCES

Disturbances to wildlife populations will have different effects based on their frequency and season of occurrence. Breeding, spawning and nesting seasons are critical time periods for the survival of various wildlife species. Wherever practicable, these have been summarized in tabular form or in the text which appears in Section 5.2.

Disturbances can take on various forms, including direct human interaction, nuisance intervention or predation by pets or feral animals, and impacts due to vehicular or boat traffic. Unfortunately, the most vulnerable time periods for many wildlife species coincides with the peak use periods for bathing beaches and boating. Year-round habitation would generally impose a greater impact on finfish, shellfish and waterfowl populations than would seasonal habitation. This is due to the fact that legal hunting or harvesting seasons for these resources typically fall between the months of November through April.

Oak Island is the only residential community in the study area which is seasonally occupied. The remaining communities have a mixture of year-round and seasonal residents. Due to its seasonal nature, and the fact that it is isolated from other land masses, Oak Island holds the least potential for impacting wildlife resources in the study area.

5.5 LEGISLATION, REGULATIONS AND STANDARDS

5.5.1 FEDERAL REGULATIONS

A. *Section 404 Of The Clean Water Act*

The 1972 Federal Water Pollution Control Act was amended in 1977 and renamed the Clean Water Act. Section 404 of the Clean Water Act expanded the role of the U.S. Army Corps of Engineers (ACOE) as the protector of federal wetlands, and prohibited the discharge of dredge or fill material into navigable waters without a permit from the ACOE. Section 404 contains the following provisions (Salvesen, 1990):

- Authorizes the ACOE to issue permits for filling navigable waters in accordance with EPA guidelines that..."no discharge of dredged or fill material be permitted if a practicable alternative exits which would have less adverse impact on the aquatic ecosystem...and...no discharge of dredged or fill material shall be permitted which will cause or contribute to significant degradation of U.S. Waters."
- Empowers EPA to veto a decision by the ACOE to issue a permit to fill a wetland.
- Authorizes the ACOE to issue General Permits on a statewide, regional or nationwide basis for certain activities in wetlands that are similar in nature and will cause only minimal adverse effect to the environment.
- Exempts certain activities from the permit requirements, including normal farming, forestry and ranching activities which are part of an established operation.

B. ***The Endangered Species Act***

The Endangered Species Act was enacted in 1973 and amended in 1988. It is administered primarily by the U.S. Department of Interior Fish and Wildlife Service, which oversees the protection and conservation of all forms of fish, wildlife and plants found to be in jeopardy. The Secretary of Commerce acting through the National Marine Fisheries Service is given similar authority for most marine organisms. The Endangered Species Act contains the following provisions which apply to conditions found within the study area:

- Directs the U.S. Fish and Wildlife Service to classify, list and/or de-list "Endangered" and "Threatened" wildlife and plant species occurring in the U.S. This may include the designation of "critical habitats" which are essential to the conservation of the listed species.
- Empowers the Secretaries of Interior and Commerce Department to issue regulations necessary for the conservation of listed species.
- Directs the agencies to develop and implement recovery plans for the continued survival of listed species.
- Authorizes the Secretaries of Interior, Commerce and Agriculture Departments to acquire lands or waters, or to provide financial assistance to any state for the conservation of resident endangered or threatened species.
- Prohibits the importing, exporting, taking, sale, transport or delivery of any listed animals and plants.
- Regulates the captivity of listed species.
- Specifies the civil and criminal penalties for violations under this act.
- Empowers all federal Secretaries of Departments with enforcement capabilities.

C. *The Migratory Bird Treaty Act*

The Migratory Bird Treaty Act, which was enacted in 1918, laid the basis for other laws such as the Migratory Bird Conservation Act of 1929 and the Duck Stamp Act of 1934. All species of migratory birds, including ducks and other waterfowl currently hunted in New York State, are protected under this federal legislation. The following provisions apply to conditions found within the study area:

- Prohibits the taking, killing or possession of any migratory bird, nest or eggs of such birds or parts thereof.
- Empowers the Secretary of the Interior Department to determine when and how migratory birds may be taken, killed or possessed.
- Prohibits the transportation of any migratory bird, nest, eggs or parts thereof across state, territory, district or foreign country boundaries.
- Authorizes any designated employee of the Department of Interior to search without warrant and arrest any violators of this Act.
- Exempts the captive breeding and sale of migratory game birds on farms and preserves.
- Mandates the Department of Interior to issues permits for the purposes of import, export, banding, marking, scientific collecting, taxidermy, falconry and other special purposes concerning migratory birds.

5.5.2 STATE REGULATIONS

A. *ECL Article 24 - Freshwater Wetlands Regulations*

Article 24 was enacted on September 1, 1975 to preserve, protect and conserve freshwater wetlands and the benefits derived from them. This article includes the following provisions (Rawinski, Malecki and Mudrak, February 1979):

- Empowers NYSDEC to regulate the development and use of wetlands which are 12.4 acres or greater in size, and wetlands smaller than 12.4 acres which are deemed by NYSDEC to be of unusual local importance. The regulated area extends to 100 feet beyond the designated wetland boundary.
- Regulated activities include dredging, draining, filling and potential polluting activities.
- Directs NYSDEC to inventory freshwater wetlands.
- Mandates NYSDEC to issue permits for any use or alteration of regulated freshwater wetlands.
- Defines those activities which are exempt from permit requirements, such as all agricultural activities which do not involve the filling of wetlands.

B. *ECL Article 25 - Tidal Wetlands Regulations*

The Tidal Wetlands regulations went into effect in August of 1977. The intent of this article is to ensure that uses of tidal wetlands and adjacent areas are compatible with the preservation, protection and enhancement of these lands. Article 25 includes the following provisions:

- Defines a spectrum of land use activities from compatible to incompatible within the intent of this article.
- Details the set-back requirements and minimum lot sizes for buildings and appurtenances.
- Mandates NYSDEC to issue permits for any use or alteration of tidal wetlands. The regulated area extends generally 300 feet landward of the designated wetland boundary; or up to the seaward edge of existing (as of August 20, 1977) man-made structures; or to the elevation contour of 10 feet above mean sea level; or the topographic crest of a bluff or cliff.
- Directs NYSDEC to establish a public hearing forum.
- Directs NYSDEC to inventory tidal wetlands.
- Empowers NYSDEC with enforcement capability.

5.5.3 TOWN REGULATIONS

A. ***Town Zoning***

Recognizing that trees, shrubs and associated vegetation are valuable to Town residents (in terms of stabilizing soil, reducing water pollution, abating noise, providing wildlife habitats, etc.), regulations controlling the clearing of land have been integrated into the Town Zoning Codes. Sections 213-369 through 213-375 stipulate that any person wishing to clear lands within the Town of Babylon, must first obtain a permit from the Building Division of the TOB Department of Planning and Development. In addition, the applicant must post a performance bond for such work, which remains effective for three years.

B. ***Other Town Codes***

There are several other town codes in place which contain provisions for protecting the natural resources found within the study area. These area briefly described as follows:

<u>Chapter 81 - Beaches and Recreational Areas</u>

- The Town maintains a certain degree of control over public access to its beaches through a permit system. Beach permits are solely dispensed to Town residents, and may be revoked by the Town Board if the permittee violates any of the permit conditions.
- All vehicular traffic is restricted from primary dunes, back dune areas, tidal marshes, and the Cedar Beach Tern Colony, except at designated access points.

- Pedestrian traffic is also prohibited from primary dune, back dune areas and all colonial waterbird colonies located on the barrier beach except for posted access points at elevated walkways or specially designed dune crossing structures.
- The removal of vegetation from any dune area is prohibited.
- No pets are allowed on any Town beaches or recreational areas except at animal shelters.

Chapter 86 - Boats

- Sections 17 and 18 are aimed at maintaining high surface water quality by prohibiting the discharge of oil, chemicals, cesspool wastes, garbage, rubbish and toilets into open surface waters.

- Trawling and net fishing are prohibited within the Town waters of Great South Bay, its tributaries and the Fire Island Inlet.

Chapter 106 - Dogs and Other Animals

- Requires all dogs to be properly licensed, contained on the owner's property or properly restrained on other premises. The Town's Dog Control Officer is authorized to seize all dogs that are unrestrained off the owner's property.
- Requires dog owners to clean-up dog wastes deposited anywhere off the owner's property.
- Limits the number of dogs allowed on residential properties based upon the lot size, unless granted special permission by the Town Board. Section 22 sets forth the application procedures for obtaining special permission.
- Requires the owner of a dog or any other animal to tether or leash animals when they are off the owner's premises, except with the consent of property owner for the sole purpose of hunting.

- Limits the number of fowl which can be kept on any property within the Town, and stipulates the type of building or enclosure required.

Chapter 128 - Freshwater Wetlands

- Empowers the Town of Babylon Department of Environmental Control (TOBDEC) to regulate activities within the Town's freshwater wetlands (as identified on NYSDEC maps filed with the Town Clerk's office). The Town's regulated area extends generally 100 feet beyond the mapped boundary.
- Regulates activities include draining, dredging, excavation, dumping, filling, construction, pile driving, and discharging any potential pollutants.
- Mandates TOBDEC to issue permits for any regulated activity in a freshwater wetland or adjacent area.
- Defines the activities which are exempt from permit requirements including: the deposition or removal of natural wetland products by fishing, shellfishing, aquaculture, hunting or trapping, or otherwise

legally permitted and regulated; normal agricultural practices as defined and scheduled within a Soil and Water Conservation Plan developed by a Soil and Water Conservation District; public health activities; public utility activities; emergency activities; and any activities within a wetland located in more than one town or village.

- Establishes a public hearing process for the review of permit applications.
- Authorizes the Town to require the permittee to post a performance bond for all restoration costs, that may result from the failure of work to comply with permit conditions.
- Empowers the Town Attorney to prosecute violators.

Chapter 183 - Shellfish

- Empowers TOBDEC to regulate the taking of shellfish from underwater Town lands.
- Directs the Town Clerk to issue either a personal permit or commercial permit to Town residents.
- Sets the season, quantity and size restrictions on the types of shellfish taken, and allowable methods of harvesting.
- Establishes underwater management areas which are subject to additional restrictions and regulations (over and above NYSDEC closure limits) per direction from the Commissioner of TOBDEC. The current management areas include the West Gilgo Beach Lagoon, the Cedar Beach Marina, the waters surrounding Oak Island (except to the west), and the State Boat Channel and waters south to the Robert Moses Bridge.
- Prohibits commercial shellfish harvesting in the management areas of West Gilgo Beach Lagoon and the waters located north, south, and east of Oak Island. Section 183-22 contains one exception; waters in the Oak Island Lead (southerly waters located between Oak Island and the barrier) are seasonally open to commercial shellfish harvesting in January and February.
- Affords a special exemption to Oak Island residents holding personal permits, their subtenants and guests permitting the taking of shellfish within the management area north, east and south of Oak Island, subject to all other provisions of this code.
- Establishes fines and terms of imprisonment for violators of the chapter provisions, the permit prohibitions, restrictions or regulations. Fines and sentences increase substantially for second or subsequent convictions.

Chapter 202 - Trees

- Prohibits the cutting, removal or damaging of any tree on public or private property without prior written consent of the owner.
- Sets forth a monetary penalty (not to exceed $250) or an imprisonment term (maximum of 15 days) or both for each violation. Each tree illegally cut, removed or damaged constitutes a separate violation.

Chapter 209 - Off-road Vehicles

- Prohibits the use of off-road vehicles on any roads, streets, public lands, parks, beaches and private property, without permission from the property owner.
- Sets forth a monetary penalty (not to exceed $250) or an imprisonment term (maximum of 15 days) or both for the violation. In addition, the violator shall pay all costs and expenses incurred by the Town in determining the violation.

5.6 MITIGATION ALTERNATIVES CONCERNING COASTAL BOTANY

5.6.1 TIDAL WETLANDS

As discussed in Sections 5.1.1 and 5.3.1, tidal wetlands constitute the major component of the natural ecosystem which has been impacted historically by dredging and filling operations. However, based on CA's field inventory and analysis of NYSDEC wetland maps, the coastal communities have had a relatively minor impact on the tidal wetland system for the past 30 years. The extent of tidal wetlands appears to be increasing and enveloping many of the man-made structures installed years ago, as evident on Oak Island. The marsh grass density study conducted by EEA, Inc. indicates that there is no statistical difference between densities recorded at undeveloped versus developed areas (EEA, Inc., January 1991).

The current impacts on tidal wetlands by the coastal communities are infrequent and limited in extent, and may readily be diminished by instituting minor regulatory changes and increasing enforcement. As discussed in Sections 5.1.1 and 5.3.5, residents in Gilgo East, Oak Island and Captree Island have been clearing and/or mowing tidal wetland vegetation adjacent to homes, roadways and community recreation areas. The Town has recently reached a preliminary agreement with NYSDEC regarding the extent of clearing which will be allowed without prior permit approval from NYSDEC (as discussed in Section 5.3.5). This policy, which has been developed for the Gilgo East community, is expected to be expanded in scope to apply to all of the Town's coastal communities.

Enhanced Town regulatory control over activities in tidal wetlands can be derived through the creation and adoption of a Town ordinance, similar to Chapter 128 of the Town Codes which regulates freshwater wetlands. Subsections may include: the provisions of the mowing policy; restrictions on the type, distribution or rate of fertilizer applications; scheduling and reporting dye testing of existing septic systems; provisions for removing outhouses set in wetland areas and modifications of failing septic systems. Such a code can offer better Town control over the types of structures and use of structures located within tidal wetlands and the specified adjacent area.

The Town may request NYSDEC to update their inventory and map the transitional wetland identified by CA in the Oak Beach Association in order to provide the proper degree of protection to this system. In addition, the Nature Conservancy has requested similar treatment for the unmapped wetlands (mudflats or interdunal swales) that exist at Overlook Beach, since they are integral to the recently designated Town refuge area (Antenen, December 18, 1992).

5.6.2 FRESHWATER WETLANDS

West Gilgo Beach has had a moderate impact on a relatively large freshwater wetland located north of the residential area. As discussed in Section 5.1.2, it is apparent that community residents are generally unaware of the presence of this wetland due to the fact that it primarily occupies undeveloped areas which are difficult to access, and that a portion (approximately one acre) is kept mown for a ballfield. Relocation of this ballfield to an alternate upland site would minimize the impacts to this freshwater wetland. Based upon preliminary field observations, an alternate location may be available further west, within the undeveloped portion of the West Gilgo community. However, further study will be required to determine the suitability of the soils and the configuration of the ballfield to avoid other sensitive wetland and dune areas. Enhanced enforcement of the Town's freshwater wetlands ordinance would reduce the dumping of yard wastes and other rubbish which is occurring along Ocean Walk.

Chapter 128 of the Town Codes regulating freshwater wetlands utilizes the NYSDEC inventory maps to set the Town jurisdictional boundaries. As discussed in Section 5.1.2, the freshwater wetlands identified by CA in West Gilgo Beach are not currently depicted on the NYSDEC maps. The Town may request NYSDEC to consider these wetlands for inclusion and mapping, and to establish a classification as to their relative importance as wildlife habitats. An educational campaign spearheaded by the Ad-hoc committee or the West Gilgo Beach community association, would bolster public awareness of these systems, their importance, functions, and values. A limited harvest of Large Cranberry, a

natural product of the larger freshwater wetland, may boost the local stewardship sentiment.

As discussed in Section 5.1.2, the large freshwater wetland system located in the Oak Beach Association is relatively undisturbed and has not been impacted by the community. However, the westernmost segment has undergone a transition to a tidal wetland system, due to past activities of the Suffolk County Bureau of Vector Control. In line with the mitigation measures stated above, the Town may request NYSDEC to drop the freshwater classification for this segment, and reclassify it as a tidal wetland. Additional freshwater wetlands occupying the interdunal areas east of Oak Beach Association, north of West Gilgo Beach and potentially north of the Oak Island community should also be considered for inclusion on NYSDEC freshwater wetland maps and subject to Town regulatory control.

5.6.3 UPLANDS, WOODLANDS AND URBAN VEGETATION

The monoculture of Japanese Black Pines which currently exists throughout the study area is in serious threat of decline due to Pine Wilt Disease, as discussed in Sections 5.1.3, 5.1.5, and 5.3.3. Although this situation is not directly due to any community activities, these same communities have the opportunity to take immediate action and effect a significantly positive impact on the upland and woodland habitats of the coastal barrier. Knowledgeable residents or their representatives from the communities might form a local coalition (similar to a citizens advisory committee) to assess the existing condition of the Japanese Black Pine stand (both within the community areas and along the state right-of-way), to determine the "hot-spots" or leading lines of disease transmission and to coordinate monitoring efforts with NYSDEC, NYSDOT and Long Island State Parks. Upon the development of an overall Landscape Management Plan for the barrier island, NYSDEC staff indicated that the state agencies would be amenable to the removal of diseased trees and replacement with suitable species. However, community volunteer efforts and some matching funds may be necessary (Sinclair, NYSDEC, December 17, 1992). NYSDEC also stated that the primary goals of such a reforestation effort should include maximizing species diversity, and replacing with native and deciduous plants in the proper locations. Revisions to Chapter 202 of the Town Codes would be necessary to embark on this effort. Code revisions may include the formation of a citizen's tree coalition to develop long term plans and management strategies. In order to be effective, the coalition should be given some authority to grant approvals.

As discussed briefly in Section 5.3.2, the ecology of the coastal communities would greatly benefit by the replacement of typically ornamental plant species within developed areas with more native species. Many of these native species are readily available at Long Island nurseries. The Nassau and Suffolk County Cooperative Extension offices can assist with locating sources for native plants which are grown in nurseries from wild collected seed or plant parts without damaging or removing stock from the wild. Some recommended native plants, include the following:

- Trees or large shrubs - shadbush (Amelanchier canadensis), red maple (Acer rubrum), red chokeberry (Aronia arbutifolia), Atlantic white cedar (Chamaecyparis thyoides), sassafras (Sassafras albidum), Eastern red cedar (Juniperus virginiana), tupelo or blackgum (Nyssa sylvatica), and black willow (Salix nigra);

- Shrubs - groundsel bush (Baccharis halimifolia), leatherleaf (Chamaedaphne calyculata), sweet pepperbush (Clethra alnifolia), black huckleberry (Gaylussacia baccata), sheep laurel (Kalmia angustifolia), black haw viburnum (Viburnum prunifolium), northern bayberry (Nyrica pensylvanica), beach plum (Prunus maritima), swamp azalea (Rhododendron viscosum), winged sumac (Rhus copallina), smooth sumac (Rhus glabra), staghorn sumac (Rhus typhina), pasture rose (Rosa virginiana), meadowsweet (Spiraea latifolia), lowbush blueberry (Vaccinium angustifolium), and highbush blueberry (Vaccinium corymbosum); and

- Groundcovers, perennials, and grasses - beachgrass (Ammophila breviligulata), big blue stem (Andropogon gerardi), little bluestem (Andropogon scoparius), bearberry (Arctostaphylos uva-ursi), butterfly weed (Asclepias tuberosa), stiff aster (Aster linariifolius), New England aster (Aster novae-angliae), sweetfern (Comptonia peregrina), joe pyeweed (Eupatorium purpureum), salt meadow cordgrass (Spartina patens), sea lavender (Limonium carolinianum), American cranberry (Vaccinium macrocarpon), bird's foot violet (Viola pedata), and sweet goldenrod (Solidago odora).

5.6.4 DUNES AND BEACHES

Concentrated pedestrian traffic by the residents of the Gilgo East, and West Gilgo Beach communities has had a significant impact on dune vegetation opposite Ocean Parkway to the south, as discussed in Section 5.1.4. Several of these dune walkovers are directly in line with reported occurrences of the rare plant species, such as seabeach amaranth and seabeach knotweed. Dune walkovers directly impact dune vegetation and pose a threat to these rare plants. These impacts could be eliminated through stepped up enforcement of Chapter 81 of the Town Codes which prohibit both the removal or destruction of dune vegetation and pedestrian traffic through dune areas, except at designated walkways. The construction of elevated dune crossovers, the posting of restricted use signs, and the installation of additional fencing bordering the south side of Ocean Parkway to channel pedestrian flow to these designed crossovers would provide a passive alternative to active enforcement activities.

Also discussed in Section 5.1.4, is the potential presence of additional rare and vulnerable plant species along the community beachfronts and adjacent undeveloped areas. Although unlikely to occur in highly traversed pathways, these rare plants may be present behind coastal structures. A rare plant survey conducted by a qualified botanist would be necessary to verify such occurrences and to develop a management plan if necessary.

5.7 MITIGATION ALTERNATIVES CONCERNING WILDLIFE RESOURCES

5.7.1 ENDANGERED, THREATENED, SPECIAL CONCERN SPECIES AND OTHER BIRDS

Largely through the combined efforts of NYSDOS, NYSDEC, the Nature Conservancy and the Audubon Society, a considerable amount of research has been conducted on the vulnerable species discussed in Section 5.2.1 and the habitats which are critical to supporting these species. Coastal development, recreational uses, predation and environmental degradation are four of the main factors which have historically contributed to population declines of Piping Plovers, Least Terns, Common Terns and Roseate Terns (NYSDOS, April 1991). Habitat loss (especially of wetland areas) and increased human interactions/disturbances within breeding ranges were cited as the primary factors controlling Northern Harrier populations on Long Island (England, 1989). Although they primarily utilize habitats outside of the community areas, all of these vulnerable species nest and/or forage within close proximity (less than one-half mile) to the residential developments and recreational facilities of the study area. Management considerations designed to protect the endangered and threatened species, discussed in Section 5.2.1, will also generally apply to other bird species.

The Town has recently designated part of Overlook Beach as a wildlife refuge to protect vital habitat for the Piping Plover. The Nature Conservancy is currently developing a site management and conservation plan for this refuge (Antenen, December 18, 1992). These efforts could be expanded in scope by designating this and other important wildlife habitats as Critical Environmental Areas (CEA's). Thereafter, any action that takes place within or substantially contiguous to the CEA's would be treated as a Type I action and be subject to a fully coordinated environmental review process under SEQRA (NYSDEC, March 1982). In lieu of the designation of CEA's, the Town may establish Wildlife Management Areas, similar to those established under Chapter 183 of the Town Codes which regulate shellfish harvesting waters. A Vulnerable Species Coordinating Committee (VSCC) could be created to identify the critical habitats and buffer areas within the Town and develop management strategies for these areas. Members of a VSCC might include representatives from TOBDEC, TOB Parks, TOB Buildings and Grounds, NYSDEC, Audubon Society, Nature Conservancy, Long Island Beach Buggy Association, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, and Save the Beaches Fund.

Any measures that would restrict further development within the study area would serve to mitigate impacts of the coastal communities on vulnerable and protected avian species. Regulations which prohibit the reconstruction of residences or shoreline protection structures within Coastal Erosion Hazard Areas, will further reduce these impacts and potentially create future habitat areas.

The TOBDEC, Save the Beaches Fund, Audubon Society and members of the Long Island Beach Buggy Association annually post signs and erect string fences around nesting shorebird colonies to serve as visual barriers protecting these areas. However, based on conversations with TOB staff, the Nature Conservancy and CA's field investigations, human disturbances (including those caused by residents and non-resident visitors) and predation continue to impose moderate adverse impacts on the survival and reproductive success of ground-nesting birds in the study area. As discussed in Sections 5.2.2 and 5.2.5, improper disposal of food scraps and residential garbage attracts certain predatory species. Strict adherence to and enforcement of the Town's litter ordinance (Chapter 146 of the Town Codes) would minimize this problem. In addition, enhanced enforcement and expansion of Chapter 106 of the Town Codes to include licensure for cats, improved constraint requirements and control of feral animals would greatly reduce the impacts of predation due to the developed areas.

The Town and Save the Beaches Fund have already developed a good informational program for Piping Plovers. Further educational efforts are necessary to enhance public awareness of other vulnerable and protected avian species. A strong public message is needed to convey the negative consequences of unleashed pets, trespassing on the dunes and disturbing wildlife.

5.7.2 FINFISH, SHELLFISH AND CRUSTACEANS

As discussed in Sections 5.2.3 and 5.2.4, the overall health of marine organisms is inextricably linked to the maintenance of good surface water quality. Mitigation alternatives affecting surface water quality are discussed separately in Section 2.6. Limiting dredging activities to bottom areas devoid of aquatic vegetation, and to time periods which do not coincide with peak spawning periods, will greatly reduce the development impacts on fishery resources.

The Town and State already have regulations in effect which control the size, number and types of marine organisms that can be harvested from the waters of the study area. One provision of the Town's shellfish ordinance (Chapter 183 of the Town Codes) provides exclusionary rights to Oak Island residents. Revisions to the code to drop restrictions in this management area, or to seasonally open the waters surrounding Oak Island would afford more equitable treatment to Town residents at large.

5.7.3 MAMMALS AND FERAL ANIMALS

The direct impact of residential development on native mammalian species is relatively insignificant; when compared with the secondary effect that urbanization has caused to increase populations of certain predatory species, both native and introduced. As discussed in Section 5.2.5, certain native mammals, such as Raccoons, Opossums, and Squirrels and other opportunistic species, such as Norway Rats, have benefitted from human habitation in the outer beach areas. These species, along with both domestic and feral cats and dogs, create a potentially significant impact on other wildlife species which utilize the study area, especially ground-nesting birds.

The Town of Babylon has adopted a local ordinance (Chapter 106 of the Town Code) to control dogs and other animals, which is described further in Section 5.5.3. However, greater enforcement of this regulation may be needed to reduce the harassment to colonial nesting waterbirds along the Town beaches and other wildlife species. In addition, this code should be expanded to include licensure and constraint requirements for cats, and provisions for the control and/or disposal of feral animals. Further study will be required to determine if wildlife control measures are also needed to reduce predation on endangered, threatened and protected species.

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TABLE 5-1

PLANTS OCCUPYING THE TIDAL MARSHES*

COMMON NAME	BOTANICAL NAME
Smooth Cordgrass	*Spartina alterniflora*
Saltgrass	*Distichlis spicata*
Saltmeadow Cordgrass	*Spartina patens*
Slender Glasswort	*Salicornia europaea*
Sea Lavender	*Limonium nashii*
Perennial Saltmarsh Aster	*Aster tenuifolius*
Marsh-Elder	*Iva frutescens*
Groundsel-Tree	*Baccharis halimifolia*
Black-Grass	*Juncus gerardi*
Common Reed	*Phragmites communis*
Seashore-Mallow	*Kosteletzkya virginica*
Dogbane	*Apocynum androsaemifolium*

*NOTE: Species are listed generally in order of occurrence from wetter downgradient locations to drier upgradient locations.

Source: CA field investigations of the Babylon barrier and bay island study area conducted from September through November 1992.

TABLE 5-2

PLANTS OCCUPYING THE FRESHWATER WETLANDS AND UPLAND VICINITY*

COMMON NAME	BOTANICAL NAME
Peat Moss	*Sphagnum sp.*
Large Cranberry	*Vaccinium macrocarpon*
Marsh Fern	*Dryopteris thelypteris*
Cinnamon Fern	*Osmunda cinnamomea*
Royal Fern	*Osmunda regalis*
Sensitive Fern	*Onoclea sensibilis*
Woolgrass	*Scirpus cyperinus*
Rushes (various)	*Juncus sp.*
American Three-square	*Scirpus americanus*
Narrow-leaved Cattail	*Typha angustifolia*
Hardhack	*Spiraea tomentosa*
Blue-flag	*Iris versicolor*
Crimson-eyed Rose Mallow	*Hibiscus palustris*
Poison Ivy	*Rhus radicans*
Swamp Dewberry	*Rubus hispidus*
Beach Plum	*Prunus maritima*
Common Greenbrier	*Smilax rotundifolia*
Cat-Brier	*Smilax glauca*
Winged Sumac	*Rhus copallina*
Common Reed	*Phragmites communis*
Atlantic White Cedar	*Chamaecyparis thyoides*
Red Maple	*Acer rubrum*
Shadbush	*Amelanchier arborea*
Black Cherry	*Prunus serotina*
Black Locust	*Robinia pseudoacacia*
Sassafras	*Sassafras albidum*

*NOTE: Species are listed generally in order of occurrence from wetter downgradient locations to drier upgradient locations.

Source: CA field investigations of the Babylon barrier and bay island study area conducted from September through November 1992.

TABLE 5-3

PLANTS OCCUPYING THE OAK ISLAND WOODLANDS

COMMON NAME	BOTANICAL NAME
Shadbush	*Amelanchier arborea*
American Holly	*Ilex opaca*
Eastern Redcedar	*Juniperus virginiana*
Atlantic White Cedar	*Chamaecyparis thyoides*
Winged Sumac	*Rhus copallina*
Black Cherry	*Prunus serotina*
Fire Cherry	*Prunus pensylvanica*
Greenbrier	*Smilax sp.*
Oriental Bittersweet	*Celastrus orbiculata*
Groundsel-tree	*Baccharis halimifolia*
High-bush Blueberry	*Vaccinium corymbosum*
Beach Plum	*Prunus maritima*
Swamp Rose	*Rosa palustris*

Source: CA field investigations conducted from September through November 1992.

TABLE 5-4

PLANTS OCCUPYING DUNE AREAS

COMMON NAME	BOTANICAL NAME
Beach Heather	*Hudsonia tomentosa*
Little Bluestem	*Andropogon scoparius*
Weeping Lovegrass	*Eragrostis curvula*
Beachgrass	*Ammophila breviligulata*
Northern Bayberry	*Myrica pensylvanica*
Seaside Goldenrod	*Solidago sempervirens*
Japanese Black Pine	*Pinus thunbergii*
Common Reed	*Phragmites communis*
Groundsel-tree	*Baccharis halimifolia*
Seaside Gerardia	*Gerardia maritima*
Poison Ivy	*Rhus radicans*
Beach Plum	*Prunus maritima*
Winged Sumac	*Rhus copallina*
Virginia Creeper	*Parthenocissus quinquefolia*
Panicgrasses	*Panicum sp.*
Atlantic White Cedar	*Chamaecyparis thyoides*
Red Maple	*Acer rubrum*
Pokeweed	*Phytolacca americana*
Sweet Pepperbush	*Clethra alnifolia*
Brier	*Smilax sp.*
Switchgrass	*Panicum virgatum*
Pearly Everlasting	*Anaphalis margaritacea*
Black Cherry	*Prunus serotina*
False-nettle	*Boehmeria cylindrica*
Jointweed	*Polygonella articulata*
Sweet Cherry	*Prunus avium*
Sea Rocket	*Cakile edentula*
Pinweed	*Lechea sp.*

Source: CA field investigations of the Babylon barrier and bay island study area conducted from September through November 1992.

TABLE 5-5

LANDSCAPE PLANTS WITHIN THE BARRIER AND BAY ISLAND COMMUNITIES

(N) Denotes plant species native to the Long Island area
* Denotes introduced species with high potential for dispersal.

TREES

*	Japanese Black Pine	*Pinus thunbergii*
(N)	Scrub Pine	*Pinus virginiana*
	Colorado Blue Spruce	*Picea pungens*
(N)	Shortleaf Pine	*Pinus echinata*
	Eastern White Pine	*Pinus strobus*
	White Spruce	*Picea glauca*
(N)	Gray Birch	*Betula populifolia*
	Douglas Fir	*Pseudotsuga menziesii*
	Balsam Fir	*Abies balsamea*
(N)	American Holly	*Ilex opaca*
*	Norway Maple	*Acer platanoides*
	Scotch Pine	*Pinus sylvestris*
(N)	Black Locust	*Robinia pseudoacacia*
(N)	Atlantic White Cedar	*Chamaecyparis thyoides*
(N)	Eastern Redcedar	*Juniperus virginiana*
(N)	Silver Maple	*Acer saccharinum*
(N)	Fire Cherry	*Prunus pensylvanica*
*	Crabapple	*Malus sp.*
*	Weeping Willow	*Salix babylonica*
*	Mimosa	*Albizia julibrissin*
(N)	Northern White Cedar	*Thuja occidentalis*
	Eastern Hemlock	*Tsuga canadensis*
*	Japanese Maple	*Acer palmatum*
(N)	Pitch Pine	*Pinus rigida*

Table 5-5 (continued)

SHRUBS

(N)	Northern Arrowwood	*Viburnum recognitum*
(N)	Winged Sumac	*Rhus copallina*
*	Scotch Broome	*Cytisus scoparius*
*	Yew (various types)	*Taxus sp.*
	Japanese Spirea	*Spiraea japonica*
(N)	Smooth Sumac	*Rhus glabra*
	Common Juniper	*Juniperus communis*
	Pfitzer Juniper	*Juniperus chinensis 'pfitzerana'*
	Salt Spray Rose	*Rosa rugosa*
	Lilac	*Syringa vulgaris*
*	Autumn Olive	*Elaeagnus umbellata*
*	Russian Olive	*Elaeagnus angustifolia*
	Privet	*Ligustrum sp.*
(N)	Highbush Blueberry	*Vaccinium corymbosum*
	Gold-Dust Tree	*Aucuba japonica*
	Japanese Euonymus	*Euonymus japonica*
	Rhododendrons (various)	*Rhododendron sp.*
	Azaleas (various)	*Rhododendron sp.*
*	Basket Willow	*Salix purpurea*
	Butterfly bush	*Buddleia davidii*
*	Rose-of-Sharon	*Hibiscus syriacus*
	Japanese Holly	*Ilex crenata*
	Winged Euonymus	*Euonymus atropurpurea*
	Evergreen Euonymus	*Euonymus japonica*
	Mugho Pine	*Pinus mugo*
	Bigleaf Hydrangea	*Hydrangea macrophylla*
(N)	Sheep Laurel	*Kalmia angustifolia*
(N)	Seashore Mallow	*Kosteletzkya virginica*
	Firethorn	*Pyracantha coccinea*
(N)	Winterberry	*Ilex verticillata*
(N)	Northern Bayberry	*Myrica pensylvanica*

Table 5-5 (continued)

	Heather	*Calluna vulgaris*
	Dwarf Alberta Spruce	*Picea glauca var. albertiana*

ANNUAL AND PERENNIAL BEDDING PLANTS AND GROUNDCOVERS

	Creeping Juniper	*Juniperus horizontalis*
*	Adam's Needle Yucca	*Yucca smalliana*
*	Montauk Daisy	*Chrysanthemum nipponicum*
	Shore Juniper	*Juniperus conferta*
*	Bugleweed	*Ajuga reptans*
*	Chinese Wisteria	*Wisteria sinensis*
*	Sedum (various types)	*Sedum sp.*
(N)	Dusty Miller	*Artemisia stelleriana*
(N)	Prickly Pear	*Opuntia humifusa*
	African Daisy	*Arctotis sp.*
*	English Ivy	*Hedera helix*
	Cotoneaster (various)	*Cotoneaster sp.*
*	Tall Fescue	*Festuca arundinacea*
	Pampas Grass	*Cortaderia selloana*
	Kentucky Bluegrass	*Poa pratensis*
	Blanketflower	*Gaillardia grandiflora*
	Coleus (various)	*Coleus sp.*
	Iris (various)	*Iris sp.*
	Geranium (various)	*Pelargonium sp.*
*	Black-eyed Susan	*Rudbeckia hirta*
*	Japanese Honeysuckle	*Lonicera japonica*
	Lobelia	*Lobelia erinus*
	Zinnia (various)	*Zinnia sp.*
*	Cosmos	*Cosmos bipinnatus*
	Thyme	*Thymus serpyllum*
*	Purple Loosestrife	*Lythrum salicaria*
	Lily-of-the-Valley	*Convallaria majalis*
	Plantain Lily (various)	*Hosta sp.*

Table 5-5 (continued)

	Japanese Spurge	*Pachysandra terminalis*
*	Trumpet-vine	*Campsis radicans*
*	Daylily	*Hemerocallis sp.*
	Salvia	*Salvia splendens*
*	Snapdragons	*Antirrhinum sp.*
	Sweet Alyssum	*Alyssum maritimum*
*	Petunia	*Petunia hybrida*
	Wax Begonia	*Begonia semperflorens*
*	Marigold	*Tagetes sp.*
*	Portulaca	*Portulaca grandiflora*
(N)	Beachgrass	*Ammophila breviligulata*
(N)	Virginia Creeper	*Parthenocissus quinquefolia*
	Bigleaf Periwinkle	*Vinca major 'variegata'*
*	Oriental Bittersweet	*Celastrus orbiculata*

WILDFLOWERS, WEEDS AND VOLUNTEER GRASSES

NOTE: All of these species listed are common to mainland areas in Babylon and have high potential for dispersal.

Japanese Knotweed	*Polygonum cuspidatum*
Switchgrass	*Panicum virgatum*
Foxtail	*Setaria sp.*
Hawkweed	*Hieracium aurantiacum*
Pokeweed	*Phytolacca americana*
Common Reed	*Phragmites communis*
Witchgrass	*Panicum capillare*
Purple Lovegrass	*Eragrostis spectabilis*
Sheep Sorrel	*Rumex acetosella*
Cranesbill	*Geranium sp.*
Yarrow	*Achillea sp.*
Broomsedge	*Andropogon virginicus*
Weeping Lovegrass	*Eragrostis curvula*
Ground Ivy	*Glechoma hederacea*

Table 5-5 (continued)

Bitter Nightshade	*Solanum dulcamara*

Source: CA field investigations conducted from September through November 1992.

TABLE 5-6

PLANTS OCCUPYING FILLED GROIN AREAS AND DISTURBED MEADOWS

COMMON NAME	BOTANICAL NAME
Wormwood	*Artemisia caudata*
Queen Anne's Lace	*Daucus carota*
Seaside Goldenrod	*Solidago sempervirens*
Common Mullein	*Verbascum thapsus*
Chicory	*Cichorium intybus*
Common Ragweed	*Ambrosia artemisiifolia*
Peppergrass	*Lepidium virginicum*
Beach Cocklebur	*Xanthium echinatum*
Sweet White Clover	*Melilotus alba*
Redroot Pigweed	*Amaranthus retroflexus*
Evening Primrose	*Oenothera biennis*
Beach Pea	*Lathyrus japonicus*
Common Reed	*Phragmites communis*
Sheep Sorrel	*Rumex acetosella*
Dewberry	*Rubus sp.*
Pigweed (Unidentified spp.)	*Amaranthus sp.*

Source: CA field investigations of the Babylon barrier and bay island communities, conducted from September through November 1992.

TABLE 5-7

AVIAN SPECIES WHICH REPORTEDLY UTILIZE THE STUDY AREA

The following list of avian species was compiled from: Andrle and Carroll (1988) Atlas of Breeding Birds in New York State; Root (1988) Atlas of Wintering North American Birds; Howe, Clapp and Weske (1978) Marine and Coastal Birds; Robbins, Bruun, and Zim (1966) A Guide to Field Identification: Birds of North America; Information received from N.Y. Natural Heritage Program (1992); and field observations of the study area conducted between 7:00 a.m. to 6:00 p.m. from September 1992 through November 1992. This list has been reviewed by NYSDEC (November 1992) to delete unlikely species occurrences.

The three letters preceeding the species name indicate that the bird: "O" was OBSERVED within the study area; "W" reportedly occupies the study area in the WINTER; and "B" reportedly BREEDS within the study area. The absence of "W" or "B" indicates a lack of available data or that the species is an uncommon visitor to the area.

The letters following the species name indicate the legal status of the bird in New York State as defined in New York State Environmental Conservation Law, Section 11-0535. "E" indicates that the bird is an ENDANGERED species; "T" indicates a THREATENED species; "SC" indicates a SPECIAL CONCERN species; "P" indicates that it is a PROTECTED wild species.

RAPTORS

	W	B	American Kestrel *Falco sparverius*	
			Bald Eagle *Haliaeetus leucocephalus*	(E)
			Cooper's Hawk *Accipiter cooperii*	(SC)
	W		Eastern Screech-Owl *Otus asio*	
	W		Great-horned Owl *Bubo virginianus*	
	W		Long-eared Owl *Asio otus*	
O			Merlin *Falco columbarius*	
O	W	B	Northern Harrier *Circus cyaneus*	(T)
		B	Osprey *Pandion haliaetus*	(T)
			Peregrine Falcon *Falco peregrinus*	(E)
	W		Red-tailed Hawk *Buteo jamaicensis*	
	W		Rough-legged Hawk *Buteo lagopus*	
			Saw-whet Owl *Aegolius acadicus*	
			Sharp-shinned Hawk *Accipiter striatus*	
	W	B	Short-eared Owl *Asio flammeus*	(SC)
	W		Snowy Owl *Nyctea scandiaca*	

TABLE 5-7 (continued)
AVIAN SPECIES WHICH REPORTEDLY UTILIZE THE STUDY AREA

PERCHING BIRDS

	W	B	American Crow	*Corvus brachyrhynchos*
	W	B	American Goldfinch	*Carduelis tristis*
		B	American Redstart	*Setophaga ruticilla*
		B	American Robin	*Turdus migratorius*
	W		American Tree Sparrow	*Spizella arborea*
		B	Barn Swallow	*Hirundo rustica*
O	W	B	Belted Kingfisher	*Megaceryle alcyon*
		B	Black-billed Cuckoo	*Coccyzus erythropthalmus*
O	W	B	Black-capped Chickadee	*Parus atricapillus*
	W	B	Blue Jay	*Cyanocitta cristata*
		B	Brown-headed Cowbird	*Molothrus ater*
	W		Brown Creeper	*Certhia americana*
	W	B	Brown Thrasher	*Toxostoma rufum*
	W	B	Carolina Wren	*Thryothorus ludovicianus*
	W		Cedar Waxwing	*Bombycilla cedrorum*
		B	Chestnut-sided Warbler	*Dendroica pensylvanica*
		B	Chimney Swift	*Chaetura pelagica*
		B	Common Grackle	*Quiscalus quiscula*
		B	Common Yellowthroat	*Geothlypis trichas*
	W	B	Downy Woodpecker	*Picoides pubescens*
	W		Eastern Bluebird	*Sialia sialis* (SC)
	W		Eastern Meadowlark	*Sturnella magna*
		B	Eastern Wood-Pewee	*Contopus virens*
		B	Eastern Kingbird	*Tyrannus tyrannus*
O	W	B	European Starling	*Sturnus vulgaris*
	W		Field Sparrow	*Spizella pusilla*
		B	Fish Crow	*Corvus ossifragus*
	W		Fox Sparrow	*Passerella iliaca*
O	W		Golden-crowned Kinglet	*Regulus satrapa*

TABLE 5-7 (continued)
AVIAN SPECIES WHICH REPORTEDLY UTILIZE THE STUDY AREA

PERCHING BIRDS (continued)

		B	Grasshopper Sparrow	*Ammodramus savannarum* (SC)
	W	B	Gray Catbird	*Dumatella carolinensis*
	W		Hairy Woodpecker	*Picoides villosus*
	W		Hermit Thrush	*Catharus guttatus*
	W	B	Horned Lark	*Eremophila alpestris*
O	W	B	House Finch	*Carpodacus mexicanus*
O	W	B	House Sparrow	*Passer domesticus*
		B	House Wren	*Troglodytes aedon*
		B	Kentucky Warbler	*Oporornis formosus*
			Sedge Wren	*Cistothorus platensis*
O			Magnolia Warbler	*Dendroica magnolia*
	W	B	Marsh Wren	*Cistothorus palustris*
O	W	B	Mourning Dove	*Zenaida macroura*
O			Nashville Warbler	*Vermivora ruficapilla*
O	W	B	Northern Cardinal	*Cardinalis cardinalis*
O	W	B	Northern Mockingbird	*Mimus polyglottos*
	W	B	Northern Oriole	*Icterus galbula*
			Northern Parula Warbler	*Parula americana*
		B	Orchard Oriole	*Icterus spurius*
			Palm Warbler	*Dendroica palmarum*
		B	Purple Martin	*Progne subis*
O	W	B	Purple Finch	*Carpodacus purpureus*
		B	Prairie Warbler	*Dendroica discolor*
		B	Red-breasted Nuthatch	*Sitta canadensis*
		B	Red-eyed Vireo	*Vireo olivaceus*
O		B	Red-winged Blackbird	*Agelaius phoeniceus*
	W	B	Rock Dove	*Columba livia*
	W	B	Rose-breasted Grosbeak	*Pheucticus ludovicianus*
	W		Ruby-crowned Kinglet	*Regulus calendula*

TABLE 5-7 (continued)
AVIAN SPECIES WHICH REPORTEDLY UTILIZE THE STUDY AREA

PERCHING BIRDS (continued)

		B	Ruby-throated Hummingbird	*Archilochus colubris*
	W	B	Rufous-sided Towhee	*Pipilo erythrophthalmus*
	W	B	Savannah (Ipswich) Sparrow	*Passerculus sandwichensis*
		B	Seaside Sparrow	*Ammospiza maritima*
	W	B	Sharp-tailed Sparrow	*Ammospiza caudacutus*
O	W		Slate-colored Junco	*Junco hyemalis*
	W		Snow Bunting	*Plectrophenax nivalis*
O	W	B	Song Sparrow	*Melospiza melodia*
	W		Swamp Sparrow	*Melospiza georgiana*
		B	Tree Swallow	*Iridoprocne bicolor*
	W	B	Tufted Titmouse	*Parus bicolor*
	W		White-breasted Nuthatch	*Sitta carolinensis*
		B	White-eyed Vireo	*Vireo griseus*
O	W		White-throated Sparrow	*Zonotrichia albicollis*
		B	Willow Flycatcher	*Epidonax traillii*
			Wood Thrush	*Hylocichla mustelina*
		B	Yellow-billed Cuckoo	*Coccyzus americanus*
		B	Yellow Warbler	*Dendroica petechia*
O	W		Yellow-rumped Warbler	*Dendroica coronata*
O	W	B	Yellow-shafted Flicker	*Colaptes auratus*
O		B	Yellowthroat	*Geothlypis trichas*

UPLAND GROUND BIRDS

	B	American Woodcock	*Philohela minor*
W	B	Bobwhite	*Colinus virginianus*
	B	Chuck-wills Widow	*Caprimulgus carolinensis*
W		Common Snipe	*Capella gallinago*
W	B	Ring-necked Pheasant	*Phasianus colchicus*

TABLE 5-7 (continued)
AVIAN SPECIES WHICH REPORTEDLY UTILIZE THE STUDY AREA

WATERFOWL AND SHOREBIRDS

O	W	B	American Bittern *Botaurus lentiginosus*
O	W	B	American Black Duck *Anas rubripes*
	W		American Coot *Fulica americana*
		B	American Oystercatcher *Haematopus palliatus*
	W		American Widgeon *Anas americana*
	W		Black-bellied Plover *Pluvialis squatarola*
O	W	B	Black-crowned Night Heron *Nycticorax nycticorax* (P)
		B	Black Rail *Laterallus jamaicensis* (P, SC)
	W		Black Scoter *Melanitta nigra*
		B	Black Skimmer *Rynchops niger* (P)
		B	Blue-winged Teal *Anas discors*
O	W	B	Brant *Branta bernicla*
O	W		Bufflehead *Bucephala albeola*
O	W	B	Canada Goose *Branta canadensis*
	W		Canvasback *Aythya valisineria*
		B	Cattle Egret *Bubulcus ibis*
	W	B	Clapper Rail *Rallus longirostris*
	W		Common Eider *Somateria mollissima*
			Common Gallinule *Gallinula chloropus*
	W		Common Goldeneye *Bucephala clangula*
	W		Common Loon *Gavia immer* (SC)
O		B	Common Tern *Sterna hirundo* (T)
O	W		Double-crested Cormorant *Phalacrocorax auritus*
			Dunlin *Calidris alpina*
			Forster's Tern *Sterna forsteri*
	W	B	Gadwall *Anas strepera*
O		B	Glossy Ibis *Plegadis falcinellus* (P)
O	W	B	Great Black-backed Gull *Larus marinus*
O	W		Great Blue Heron *Ardea herodias*

TABLE 5-7 (continued)
AVIAN SPECIES WHICH REPORTEDLY UTILIZE THE STUDY AREA

WATERFOWL AND SHOREBIRDS (continued)

	W		Great Cormorant	*Phalacrocorax carbo*
O		B	Great Egret	*Egretta albus* (P)
	W		Greater Scaup	*Aythya marila*
	W		Greater Yellowlegs	*Tringa melanoleucus*
		B	Green Heron	*Butorides striatus*
	W		Green-winged Teal	*Anas crecca*
		B	Gull-billed Tern	*Gelochelidon nilotica* (P)
O	W	B	Herring Gull	*Laurs argentatus*
	W		Hooded Merganser	*Lophodytes cucullatus*
	W		Horned Grebe	*Podiceps auritus*
	W	B	Killdeer	*Charadrius vociferus*
O	W	B	Laughing Gull	*Larus atricilla*
			Least Bittern	*Ixobrychus exilis* (SC)
			Least Sandpiper	*Calidris minutilla*
O		B	Least Tern	*Sterna albifrons (E)*
	W		Lesser Scaup	*Aythya affinis*
O			Lesser Yellowlegs	*Tringa flavipes*
		B	Little Blue Heron	*Florida caerulea* (P)
	W	B	Mallard	*Anas platyrhynchos*
O	W	B	Mute Swan	*Cygnus olor*
			Northern Phalarope	*Lobipes lobatus*
			Northern Shoveler	*Anas clypeata*
	W		Oldsquaw	*Clangula hyemalis*
		B	Pied-billed Grebe	*Podilymbus podiceps*
			Pintail	*Anas acuta*
		B	Piping Plover	*Charadrius melodus* (E)
	W		Red-breasted Merganser	*Mergus serrator*
			Redhead	*Aythya americana*

Table 5-7 (continued)

TABLE 5-7 (continued)
AVIAN SPECIES WHICH REPORTEDLY UTILIZE THE STUDY AREA

WATERFOWL AND SHOREBIRDS (continued)

W		Red Knot *Calidris canutus*
W		Red-throated Loon *Gavia stellata*
W		Ring-billed Gull *Larus delawarensis*
W		Ring-necked Duck *Aythya collaris*
	B	Roseate Tern *Sterna dougallii* (E)
W		Ruddy Duck *Oxyura jamaicensis*
		Ruddy Turnstone *Arenaria interpres*
W		Sanderling *Calidris alba*
		Semipalmated Plover *Charadrius semipalmatus*
		Semipalmated Sandpiper *Calidris pusilla*
		Short-billed Dowitcher *Limnodromus griseus*
		Snow Goose *Chen caerulescens*
	B	Snowy Egret *Egretta thula*
	B	Sora *Porzana carolina*
	B	Spotted Sandpiper *Actitis macularia*
	B	Tricolored Heron *Egretta tricolor* (P)
W	B	Virginia Rail *Rallus limicola*
		Western Sandpiper *Calidris mauri*
		Whimbrel *Numenius phaeopus*
		White-rumped Sandpiper *Calidris fuscicollis*
	B	Willet *Catoptrophorus semipalmatus*
	B	Wood Duck *Aix sponsa*
	B	Yellow-crowned Night Heron *Nycticorax violacea* (P)

TABLE 5-8

FINFISH OCCURRENCES IN GREAT SOUTH BAY

NOTE: SEASONAL OCCURRENCES OF JUVENILE FINFISH

"IN" - Denotes in season, occurring between Memorial Day through Labor Day
"OUT" - Denotes out of season, occurring between January through May or September through December
E - Indicates presence of Eggs
L - Indicates presence of Larval fish
A - Indicates presence of Adults

JUVENILE SEASON IN		OUT			COMMON NAME	SCIENTIFIC NAME
				A	Alewife	*Alosa pseudoharengus*
				A	American Eel	*Anguilla rostrata*
			L	A	American Sand Lance	*Ammodytes americanus*
				A	Atlantic Herring	*Clupea harengus*
		E	L	A	Atlantic Mackerel	*Scomber scombrus*
		E	L	A	Atlantic Menhaden	*Brevoortia tyrannus*
	L			A	Atlantic Needlefish	*Strongylura marina*
	L	E		A	Atlantic Silverside	*Menidia menidia*
				A	Atlantic Tomcod	*Microgadus tomcod*
				A	Barrelfish	*Hyperoglyphe perciformis*
E	L		L	A	Bay Anchovy	*Anchoa mitchilli*
E	L	E		A	Blackfish	*Tautoga onitis*
				A	Black Sea Bass	*Centropristis striata*
				A	Blueback Herring	*Alosa aestivalis*
				A	Bluefish	*Pomatomus saltatrix*
E	L				Butterfish	*Peprilus triacanthus*
E	L	E		A	Cunner	*Tautogolabrus adspersus*
				A	Dusky Shark	*Carcharhinus obscurus*
			L	A	4-Spined Stickleback	*Apeltes quadracus*
	L				Goby	*Gobiosoma sp.*

JUVENILE SEASON IN	JUVENILE SEASON OUT	COMMON NAME	SCIENTIFIC NAME	
	L	Goosefish	*Lophius americanus*	
		Gray Snapper	*Lutjanus griseus*	A
	L	Grubby	*Myoxocephalus aenaeus*	A
E		Hake	*Urophysis sp.*	A
		Hickory Shad	*Alosa mediocris*	A
E L		Hogchoker	*Trinectes maculatus*	
L	L	Lined Seahorse	*Hippocampus erectus*	
E		Mummichog	*Fundulus heteroclitis*	A
E		Northern Kingfish	*Menticirrhus saxatilis*	A
L	L	Northern Pipefish	*Sygnanthus fuscus*	A
L		Northern Puffer	*Sphoeroides maculatus*	A
		Northern Searobin	*Prionotus carolinus*	A
		Northern Sennet	*Sphyraena borealis*	A
		Orange Filefish	*Alutera schoepfii*	A
		Oyster Toadfish	*Opsanus tau*	A
		Permit	*Trachinotus falcatus*	A
		Pollock	*Pollachius virens*	A
		Rainwater Killifish	*Lucania parva*	A
		Sand Bar Shark	*Carcharhinus milberti*	A
		Sand Shark	*Odontaspis taurus*	A
		Scup	*Stenotomus chrysops*	A
E		Searobin	*Prionotus sp.*	A
		Sheepshead Minnow	*Cyprinodon variegatus*	A
		Sheepshead Porgy	*Archosargus probatocephalus*	A
		Silky Shark	*Carcharhinus falciformis*	A
		Silver Perch	*Bairdiella chrysura*	A
E		Smallmouth Flounder	*Etropus microstomus*	
		Smooth Dogfish Shark	*Mustelus canis*	A
		Smooth Trunkfish	*Lactophrys triqueter*	A

JUVENILE SEASON IN		OUT			COMMON NAME	SCIENTIFIC NAME
				A	Spotted Hake	*Urophycis reguis*
				A	Sting Ray	*Dasyatis centroura*
		E			Striped Anchovy	*Anchoa hepsetus*
	L				Striped Burrfish	*Chilomycterus schoepfi*
E	L				Striped Cusk Eel	*Ophidion marginata*
				A	Striped Killifish	*Fundulus majalis*
				A	Striped Mullet	*Mugil cephalus*
				A	Striped Searobin	*Prionotus evolans*
				A	Summer Flounder	*Paralichthys dentatus*
	L			A	3-Spined Stickleback	*Gasterosteus aculeatus*
				A	Tidewater Silverside	*Menidia beryllina*
	L				Weakfish	*Cynoscion regalis*
				A	White Hake	*Urophycis tenuis*
				A	White Mullet	*Mugil curema*
E	L	E	L	A	Windowpane	*Scopthalmus aquosus*
		E	L	A	Winter Flounder	*Pleuronectes americanus*

SOURCES:

D. Monteleone, June 1992. "Seasonality and Abundance of Icthyoplankton in Great South Bay, New York". Estuaries, Vol. 15, No. 2, pp. 230-238.

P. Briggs and J.S. O'Connor, January 1971. "Comparison of Shore-Zone Fishes Over Naturally Vegetated and Sand-Filled Bottoms in Great South Bay". New York Fish and Game Journal, Vol. 18, No. 1, pp. 15-41.

R. Schreiber, May 1973. <u>The Fishes of Great South Bay</u>. Masters Thesis for the Marine Sciences Research Center, State University of New York, Stony Brook, NY.

TABLE 5-9

SHELLFISH AND CRUSTACEAN OCCURRENCES IN THE STUDY WATERS OF GREAT SOUTH BAY

COMMON NAME	SCIENTIFIC NAME
Alternate Bittium	*Bittium alternatum*
Amethyst Gem Clam	*Gemma gemma*
Atlantic Chink Shell	*Lacuna vincta*
Atlantic Flat Lepton	*Mysella planulata*
Atlantic Horseshoe Crab	*Limulus polyphemus*
Atlantic Oyster Drill	*Urosalpinx cinerea*
Atlantic Surf Clam	*Spisula solidissima*
Baltic Macoma	*Macoma balthica*
Bay Scallop	*Aequipecten irradians*
Blue-claw Crab	*Calinectes sapidus*
Channeled Whelk	*Busycon canaliculatum*
Common Awning Clam	*Solemya velum*
Common Razor Clam	*Ensis directus*
Convex Slipper Shell	*Crepidula convexa*
False Quahog	*Pitar morrhuana*
Flat Slipper Shell	*Crepidula plana*
Glassy Lyonsia	*Lyonsia hyalina*
Hard-shelled Clam	*Mercenaria mercenaria*
Lady Crab	*Ovalipes ocellatus*
Little Surf Clam	*Solemya velum*
Long-clawed Hermit Crab	*Pagurus longicarpus*
Minute Hydrobia	*Hydrobia totteni*
Mud Crab	*Neopanope texana*
Mud Dog Whelk	*Nassarius obsoletus*
Northern Dwarf Tellin	*Tellina agilis*
Ostracod	*Subclass Ostracoda*
Parchment Worm Crab	*Pinnixa chaetopterana*
Rock Crab	*Cancer irroratus*
Salt Marsh Snail	*Melampus bidentatus*

Table 5-9 (continued)

Spider Crab	*Labinia dubia*
Thick-lipped Oyster Drill	*Eupleura caudata*

SOURCE: Greene, Greg. 1981. Hard Clams, Competitors, Predators, and Physical Parameters in Great South Bay. Wapora, Inc. under contract with USEPA No. 68-01-4616, New York, NY.

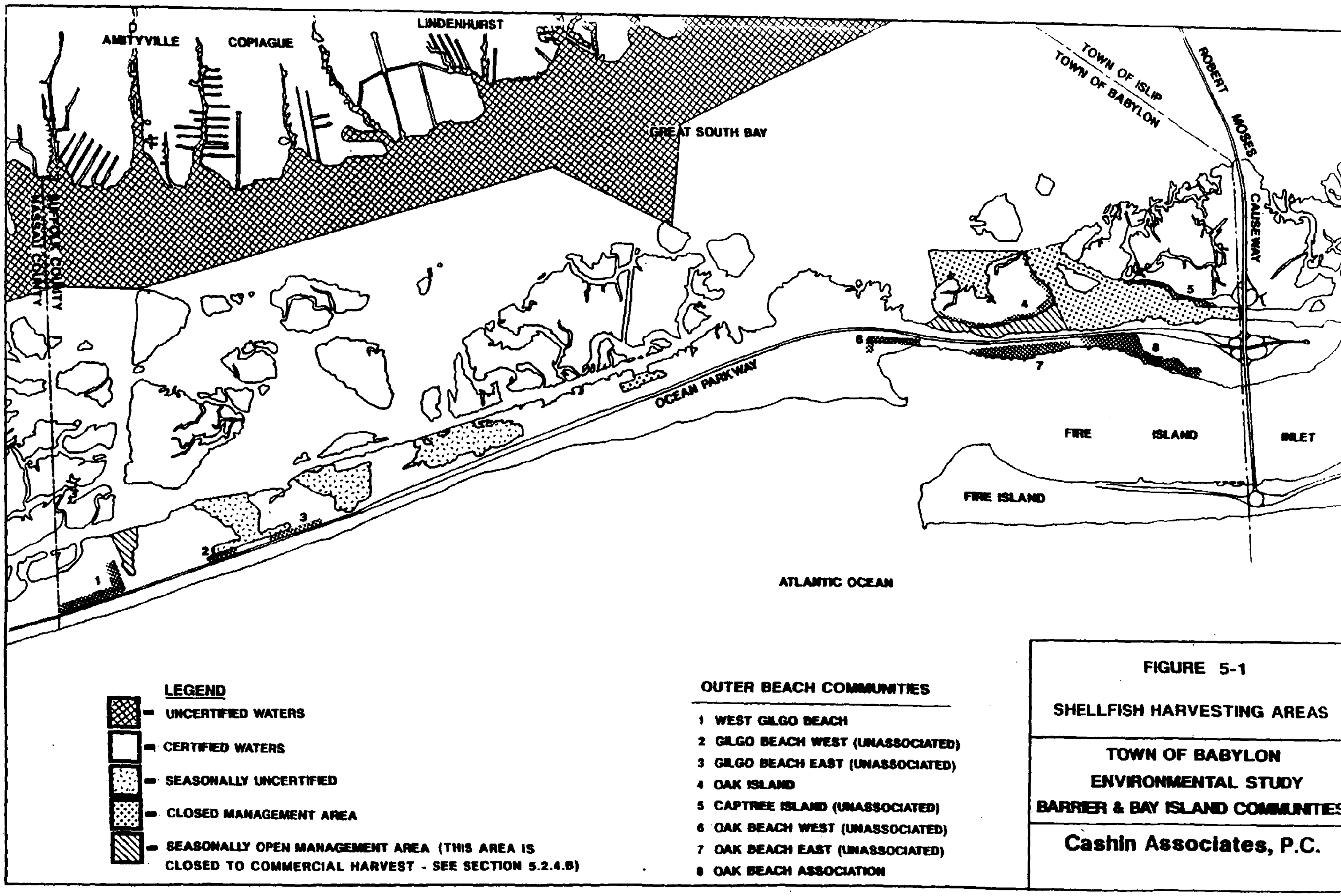
TABLE 5-10

MAMMALS OCCUPYING THE STUDY AREA

NOTE: O = Observed in study area
M = Field signs observed, such as tracks, droppings, etc.
E = Expected to utilize study area based on habitats available

	COMMON NAME	SCIENTIFIC NAME
M	Eastern Cottontail	*Sylvilagus floridanus*
O	Eastern Gray Squirrel	*Sciurus carolinensis*
M	Red Fox	*Vulpes fulva*
E	Woodchuck	*Marmota monax*
E	Eastern Chipmunk	*Tamias striatus*
E	Muskrat	*Ondatra zibethica*
O	Meadow Vole	*Microtus pennsylvanicus*
E	Pine Vole	*Pitymus pinetorum*
E	Opossum	*Didelphis marsupialis*
E	Masked Shrew	*Sorex cinereus*
E	White-footed Mouse	*Peromyscus leucopus*
M	Meadow Jumping Mouse	*Zapus hudsonias*
E	Norway Rat	*Rattus norvegicus*
E	House Mouse	*Mus musculus*
M	Raccoon	*Procyon lotor*
M	Whitetail Deer	*Odocoileus virginianus*
E	Eastern Mole	*Scalopus aquaticus*
E	Longtail Weasel	*Mustela frenata*
E	Eastern Pipistrel	*Pipistrellus subflavus*
E	Little Brown Bat	*Myotis lucifugus*

Source: CA field investigations of the Babylon barrier and bay island study area conducted from September through November 1992.


AMITYVILLE
COPIAGUE
LINDENHURST
GREAT SOUTH BAY
TOWN OF ISLIP
TOWN OF BABYLON
ROBERT MOSES CAUSEWAY
SUFFOLK COUNTY
NASSAU COUNTY
OCEAN PARKWAY
FIRE ISLAND INLET
FIRE ISLAND
ATLANTIC OCEAN
1
2
3
4
5
6
7
8
LEGEND
UNCERTIFIED WATERS
CERTIFIED WATERS
SEASONALLY UNCERTIFIED
CLOSED MANAGEMENT AREA
SEASONALLY OPEN MANAGEMENT AREA (THIS AREA IS CLOSED TO COMMERCIAL HARVEST - SEE SECTION 5.2.4.B)
OUTER BEACH COMMUNITIES
1 WEST GILGO BEACH
2 GILGO BEACH WEST (UNASSOCIATED)
3 GILGO BEACH EAST (UNASSOCIATED)
4 OAK ISLAND
5 CAPTREE ISLAND (UNASSOCIATED)
6 OAK BEACH WEST (UNASSOCIATED)
7 OAK BEACH EAST (UNASSOCIATED)
8 OAK BEACH ASSOCIATION
FIGURE 5-1
SHELLFISH HARVESTING AREAS
TOWN OF BABYLON
ENVIRONMENTAL STUDY
BARRIER & BAY ISLAND COMMUNITIES
Cashin Associates, P.C.

Section 6

SECTION 6

SECTION 6
DEVELOPMENT POTENTIAL

SECTION 6

DEVELOPMENT POTENTIAL

6.1 HISTORICAL ASPECTS OF DEVELOPMENT IN THE STUDY AREA

Prior to 1872, the south shore barrier and bay island in Babylon Town were owned and regulated by the Town of Huntington. In 1663, the Town of Huntington Trustees began supervising agricultural activities on the marsh islands in the Great South Bay (Douglas, 1992). In 1764, the Town began granting leases in this area to Town residents and select non-residents to cut salt hay for livestock feed, graze cattle, plant oysters, and dig clams and fish. Although no private homes were permitted on the islands, a small number of buildings were constructed to house watchmen who protected the oyster beds. Two such outer beach guard houses were built on Oak Island in 1845 and 1866. Whale houses were also known to exist in the area in the 1700's. In addition, in 1855, the Town of Huntington permitted the construction of a U.S. Life Saving Station at the location currently occupied by the ruins of Coast Guard station at Gilgo Beach. Life savings stations were also constructed in the Jones Beach and Tobay Beach areas around this same time.

In 1872, the Town of Babylon formally split from the Town of Huntington. Initially, Babylon Town Trustees held public auctions for the harvesting of salt hay, but no leases were authorized. In November of 1878, the Town Trustees granted eighteen Town residents twenty-one year leases to construct buildings, docks and walks at Oak Beach (then known as Oak Island Beach, because of a natural inlet that existed near Cedar Beach which bisected the barrier). According to Douglas (1992), this marked the beginning of the leasing of Town-owned public lands for recreational-residential purposes in the outer beach area. Each of the eighteen tenants agreed to pay the Town five dollars per year in rent. Additional leases were granted on Oak Beach to members of the Oyster Planters Association of Amityville and other oyster planting companies. All of these leases prohibited subletting and preserved the traditional rights of townsfolk for haying, gunning and ingress and egress. The public was allowed to freely cross the islands throughout the year, with the exception of the months of July and August, when new salt hay sprouts were vulnerable to trampling.

In 1886, the first privately-own residence was constructed on Oak Beach Island by Captain Charles B. Arnold, (a prosperous Babylon farmer who supplemented his income by working as a bayman and by serving as the keeper of the Oak Beach Island Life Saving Station). Captain Arnold operated the first ferry service from Babylon Village to Oak Island. Private summer cottages were also constructed on Oak Island, starting in 1879, by members of the Oyster Planters and Businessmen's Association of Babylon. This association had established a club house at Oak Beach in 1877 and enjoyed island life so much it inspired them to build homes in the area. Oak Island was favored for the residences because it was sheltered from storms by Fire Island and Oak Beach. Although it has not been verified, it is suspected that the Gilgo Beach area first developed as a summer community for residents from the Amityville area in the late 1800's. Residences were also established on Captree Island around the turn of the century.

The Oak Beach Association was formed in 1894 by Reverend John Dietrich Long, who secured a 50-year lease from the Town. This lease was for land at the eastern end of Oak Beach for the establishment of a religious retreat and cultural center (Douglas, 1992). Although the initial venture proved a failure, the area developed successfully as a residential colony. People eventually built more expensive homes, as compared to other homes on the barrier island, and the colony grew rapidly. Town records indicate that the Oak Island Beach Association was granted its original lease by the Trustees in March of 1896. This lease was for nine years, at a rent of $100 per year plus five dollars per year for each house. The lease was granted with a proviso that required the construction of a minimum of twenty houses prior to its expiration.

Lot maps of the first communities were prepared for the Town at the turn of the century, starting with Oak Beach in 1899 and Oak Island in 1910. In 1902 a lot map for the barrier island, extending from Gilgo Beach East to Oak Beach was prepared, showing 109 lots in the Gilgo Beach area, 48 lots in an area known as Hemlock Beach (located directly east of Gilgo in the vicinity of Hemlock Cove), and 455 lots in the Oak Beach community. At that time, the Oak Beach community, as mapped, extended east from Hemlock Cove to its present location. Another map, dated 1927 indicates the existence of 25 homes in Gilgo East and 4 homes in the area of Hemlock Cove. Other lot maps exist for the Oak Island and Oak Beach Association communities which date from the late 1890's.

In November of 1926, the Long Island State Park Commission was granted title to outer beach lands in the Town of Hempstead for the construction of the Meadowbrook Parkway, Jones Beach State Park, the Wantagh State Parkway, and Ocean State Parkway. In its desire to continue public recreational use along the full extent of the barrier island, this State Commission sought to acquire land from the Towns of Oyster Bay and Babylon. It succeeded in acquiring 500 acres of Oyster Bay meadowland on the barrier for the extension of Ocean State Parkway and lobbied Babylon Town for a portion of its public lands. In a referendum that passed by seven votes in 1928, the Long Island State Park Commission (LISPC) was ceded these lands (Caro, 1974). In all, the LISPC acquired a total of 6,775 acres of land from the Towns of Hempstead, Oyster Bay and Babylon. In 1930, the Town of Islip ceded lands on Captree Island to the Commission, clearing the way for the future connection of Ocean Parkway to the mainland via the Captree bridge. The extension of Ocean State Parkway required the relocation of the High Hill community, which was situated on leased land in the Zach's Bay section of Jones Beach, in Hempstead Town. High Hill was an organized residential community that was founded in the early 1890's. This community, which is discussed further in Section 9.1, contained 98 homes.

The LISPC acquired the land upon which this High Hill community was located when its lease expired in 1940. Around that time, arrangements were made to relocate many of the 98 residential structures to parts of Oak Beach, to the area at the west end of Gilgo Beach, and to the West Gilgo area. Boat basins were dredged in both the Gilgo and West Gilgo areas and the spoil was used as fill to accommodate the relocated homes. Approximately twenty homes were moved to Gilgo Beach West and 58 were moved to West Gilgo. An undetermined number were relocated to the Oak Beach area.

At the time that the Long Island State Park Commission was developing Ocean Parkway and the Jones Beach recreational facilities, another series of lot maps were prepared for the Gilgo and Oak Beach communities. These maps were amended to reorganize the lot configuration of the West Gilgo Beach, Gilgo Beach and Oak Beach communities to accommodate the relocation of homes from the High Hill Beach area, and to illustrate the relocation of homes within the Gilgo East area. Homes in Gilgo East were organized in a row along the bay. They had previously been spread out across the island. In the 1950's and 1960's the lot maps were once again amended by the Town Engineering Department. It is believed that these amended maps and possibly some of the 1930's maps were used as the basis for the development of the Suffolk County tax maps. No conclusive records of this exist, as no official real estate maps of the area were ever filed with the Suffolk County Clerk's Office (Gates, Real Property Tax Service, December 8, 1992). The most recent Town lot maps are very similar to the Suffolk County tax maps. They differ only in that the Town maps contain a greater number of lots per community.

Up until about 1931, there were no formal Town recreational facilities on the outer beach (Douglas, November 1992). The communities provided recreational opportunities which tended to exclusively serve the local residents who utilized them during the summer season. These areas did not offer wide-reaching recreational benefits to the general public. When Ocean Parkway was constructed, not all the Town land on the barrier island was given to the Long Island State Park Commission. Some land was retained for continued residential use as well as for the establishment of Town parkland. Additionally, Ocean Parkway was constructed to provide a number of underpasses to permit continued public access to the oceanfront. The Town-built pavilions in Cedar Beach and Gilgo Beach. One pavilion, that had been recently constructed, was destroyed in the hurricane of 1938 (Douglas, 1990).

The September 1938 hurricane also damaged about fifty homes in the Oak Beach area. The Town made no effort to discourage the reconstruction of these homes. By the winter of 1938-39, most of the 50 dislocated cottages were restored (Douglas, September, 1990). The Town also granted some lot changes to residents who wished to relocate to lots deemed safer from future hurricanes, but other requests were denied.

Jones Beach was officially opened in August of 1929, followed by Robert Moses State Park in 1939, and Town of Babylon Beach in 1940. Although public recreation facilities were opening on the barrier island, full utilization did not occur until 1954, when the Captree Bridge (now known as the Robert Moses Causeway) was opened. Prior to this, Town residents could access Outer Beach parks via the Wantagh Parkway. Captree State Park was officially opened in June of 1954. The history of public recreation facilities in the study area is discussed in Section 9.1.

Upon the provision of more open access to the area, residential development expanded and public recreational facilities became well utilized. By 1960 there were 402 homes in the study area. Today there are 415.

6.2 EXISTING LAND USE AND DEVELOPMENT PATTERNS

The Babylon barrier and bay island study area consist predominantly of residential, public open space and recreational land uses. There are also a small number of commercial uses (Figure 6-1). Much of the land in the study area is vacant and undeveloped (Table 6-1). The bay islands alone constitute roughly 2,302 acres of land area, of which only a small portion (approximately 34 acres or 1.5 percent) is developed (Real Property Tax Service, Riverhead, NY 1992). The 8.7 mile stretch of barrier island that is located within the study area encompasses approximately 2,234 acres of land. Some 149 acres (or 6.7 percent) of this land area contains residential and commercial uses. Another estimated 285 acres is utilized as formal public recreation space. Approximately 1618 acres remains vacant and undeveloped (including the undeveloped 1,223 acres which constitute Gilgo State Park). The remaining 182 acres of land on the barrier island is developed as the Ocean State Parkway and its right-of-way. The area of the Great South Bay that extends north from the barrier island to the Babylon Town mainland contains approximately 9,776 acres of underwater land that is under the jurisdiction of the Town of Babylon.

6.2.1 DESCRIPTION OF LAND USE WITHIN THE STUDY AREA

The residential development in the study area is distributed among six separate communities, which contain a total of 415 residential dwelling units. This number was derived using Suffolk County tax map information, 1992 aerial photographs, Town of Babylon Lot maps for the individual communities, and Town tax assessor's records for the study area. As shown in Figure 6-1, the six residential communities, include (from west to east): West Gilgo Beach (which contains 80 dwelling units); Gilgo Beach, which is divided into two sections referred to in this report as Gilgo Beach West (containing 35 dwelling units) and Gilgo Beach East (containing 22 dwelling units); Oak Island (which contains 54 dwelling units); Oak Beach, which is divided into two sections referred to in this report as Oak Beach West (containing 24 dwelling units) and Oak Beach East (containing 96 dwelling units); Oak Beach Association (which contains 72 dwelling units); and Captree Island (which contains 32 dwelling units).

As discussed in Section 6.1 the residential communities in the study area have been established on public land. These lands are owned by the Town of Babylon and leased to residential tenants. The West Gilgo

Beach, Oak Island and Oak Beach Association communities are managed by community associations. These associations enter into lease agreements with the Town and then sub-lease individual properties to residential tenants. The community associations oversee land use activities within their respective communities through the leasehold agreements, and through established by-laws and rules and regulations. Residential tenants in the unassociated areas enter into lease agreements directly with the Town. In this case the Town oversees community land use and development activities. The leasehold agreements and the legal restrictions contained therein are discussed in greater detail in Section 6.3.4.

As discussed in Section 6.1, the residential communities in the study area originated as seasonal enclaves of summer homes. Only Oak Island, which has 54 homes, has remained entirely a permanent seasonal community. According to the 1990 census, of the 415 dwelling units currently existing in the study area, 222 or 53 percent are occupied on a seasonal basis (R. Fedelem, LIRPB, December 17, 1992). This represents a 10.4 percent decrease since 1980, when 245 or 59 percent of the then existing 418 dwellings were used for seasonal occupation. In 1960, 351 or 87 percent of the then existing 402 homes were seasonally occupied. Since the lease agreements were extended in 1990 through the year 2050, it is expected that the trend toward year-round residential use will continue.

The recreational uses found in the study area consist of both formal Town and State-operated recreational facilities and more informal places where people gain access for recreational purposes. These recreational facilities comprise the vast majority of the acreage barrier island portion of the study area (Figure 6-1).

The Town of Babylon owns and operates the Gilgo Beach and Boat Basin, which encompasses approximately 65 acres at the western end of the study area (Figure 6-1). The Town also owns and operates Cedar Beach and Overlook Beach (approximately 173 acres combined), two adjoining facilities that are centrally located along the ocean front in the study area. The Cedar Beach Marina, which is located on approximately 10 acres of land owned by the state, is another Town-operated recreational facility. The State granted an easement to the Town in 1957 for the use of this facility. Oak Beach Park, is a small waterfront park (less than 2 acres) located in the Oak Beach area, directly east of the Oak Beach Inn. This facility, which contains a boat launch ramp, is also operated by the Town of Babylon. Ownership of this property is uncertain at the present time due to pending litigation.

The only State-owned recreational facility in the study area is Gilgo State Park. This park is composed of approximately 1,223 acres of undeveloped land including both bay-side dunes and tidal marsh lands, and ocean front dunes and beach area. This facility is informally utilized by surfcast fishermen and off-road vehicles that access the site via Cedar Beach or at an entry point located east of Cedar Beach, near the Oak Beach West community.

There are five commercial land uses in the study area including three commercial businesses and two private yacht clubs (Figure 6-1). The three businesses include: the Gilgo Inn, located at the Gilgo Beach Boat Basin; the Oak Beach Inn, located between the Oak Beach and Oak Beach Association communities, along the shorefront of Fire Island Inlet; and Frank and Dick's fueling and bait dock, located on the southern portion of Seganus Thatch, on the south side of the State boat channel (See Plates 3A through 3C, and 3F). The private yacht clubs include the Seaford Harbor Yacht Club and the Unqua Corinthian Yacht Club. Both of these facilities are located in the West Gilgo Beach area, and have access to the bay. All of the commercial uses, are located on public land leased from the Town of Babylon, with the exception of the Oak Beach Inn which is in litigation to determine ownership.

6.2.2 IDENTIFICATION OF VACANT PROPERTIES IN THE STUDY AREA

Vacant land in the study area consists of the marsh islands in Great South Bay, unutilized portions of Gilgo State Park, and the undeveloped open areas located in the vicinity of the residential communities on the barrier island. The undeveloped open area includes the lands located north and west of the West Gilgo Beach community; the land area extending to the west and east of the Gilgo Beach community; most of Oak Island; most of the stretch of land located north of Ocean Parkway, between Gilgo State Park and the Robert Moses Causeway right-of-way; the land area situated south of the Oak Beach West community (the Sore Thumb area); and the land located east of the Oak Beach Association (Figure 6-1). Vacant lands in the study area also include individual vacant parcels located within the residential communities. These vacant lands are comprised mostly of wetlands (both tidal and freshwater), dunes, beaches and upland areas that are vegetated with shrub thicket. Some of the undeveloped area on Oak Island contains woodlands. These areas are described in greater detail in Section 5.1.

To determine the number and location of individual vacant parcels within the residential communities, aerial photographs, official Suffolk County tax maps (SCTM) and Town of Babylon (TOB) lot maps were examined. As shown in Table 6-2, out of a total of 495 Suffolk County tax lots, 68 were found to be vacant. The analysis of the TOB lot maps revealed a total of 766 lots, of which 340 were vacant. When comparing the SCTM's with the TOB maps, it was found that many of the vacant Suffolk County lots were large, individual lots that encompassed several vacant Town lots thereby reducing the overall number of vacant lots on the County maps. The existing vacant SCTM properties in the study area are shown in Plates 6-A through 6-F.

6.3 EXISTING LAND USE CONTROLS

Development activities in the study area are governed by a number of land use regulations set forth at the Town, County and State level. In addition, there are legal restrictions contained in the leasehold agreements and community association by-laws which govern activities in the study area communities. The various development regulations are discussed below.

6.3.1 TOWN OF BABYLON RESTRICTIONS

The Babylon Town Code contains a number of laws that regulate land use activities in the study area. These are described as follows:

A. ***Zoning - Chapter 213***

The Town's policy is to consider the study area as being Zoned B-Residence, although no zoning designation for this land has been formally adopted because the Town owns this land. Permitted uses in a B-Residence district include one-family dwellings, churches, public parks and playgrounds, college and universities, schools, customary agricultural occupations, professional offices, golf courses and country clubs, and accessory structures (TOB Code, July 1954). The minimum lot area in a B-Residence zone is 10,000 square feet and the minimum lot width is 80 feet along the front building line. The maximum permitted lot coverage is 20 percent of the total lot area. Additional zoning requirements for the B-Residence district are outlined in Table 6-3.

According to the Town's policy, any new development or redevelopment in the study area is subject to the standards and requirements of this zoning ordinance. Development actions in the area that do not conform to these standards must be reviewed by the Town Department of Planning and Development and the Department of Environment Control who, in turn, refer the matter to the Town Board with their recommendations. In most cases, Town Board approval is also required because the existing properties do not conform to the B-Residence zoning requirements.

B. ***Building Construction - Chapter 89***

The Building Construction law contains standards and specifications for development actions in the Town. All actions that involve the construction, alteration, or removal of structures within zoned areas of the Town of Babylon are strictly governed by Chapter 89 (TOB Code, December 6, 1969).

Any development or redevelopment action requires the filing of a building permit application with the Town Building Division of the Department of Planning and Development. Plans and specifications for the proposed project that are submitted with the application are reviewed by the Town Plans Examiner.

If a building plan is not in compliance with this Town of Babylon ordinance, changes will be recommended to bring the plan into compliance or the application will be referred by the Plans Examiner to the Town Board for final decision making (Kluesener, May 24, 1994, telephone communication).

C. ***Environmental Quality Review - Chapter 114***

In accordance with the Municipal Home Rule Law, the New York State Environmental Quality Review Act (SEQRA) and the State Environmental Quality Review Regulations, the Town of Babylon adopted local environmental quality review legislation (TOB Code, June 7, 1977). The Town of Babylon Environmental Quality Review Act (TOBEQRA) requires that all Town agencies determine whether the actions or projects they directly undertake, fund or approve may have a significant effect on the environment. If it is determined that a given action may result in significant impacts, then the preparation of an environmental impact statement is required.

When a Town agency proposes to undertake an action or project or as soon as a Town agency receives an application for funding or approval, it must be determined whether this action is subject to TOBEQRA. This assessment is based on information the applicant provides on a short environmental assessment form, which is required to be submitted with each building permit application. This form, in conjunction with the building permit application, is utilized by the Department of Environmental Control to classify the proposed action as either a Type I, unlisted, exempt, excluded or Type II action. For Type I actions, a full environmental assessment form (EAF) must be completed. For unlisted actions, a short EAF is all that is required for the purposes of determining significance. Exempt, excluded and Type II actions require no additional review.

Upon review of the environmental assessment information, the significance of the proposed action must be decided. Section 114-10 of the TOBEQRA Law contains criteria for determining whether a Type I or an unlisted action may have a significant impact on the environment. The impacts that may reasonably be expected to result from the proposed action must be compared against the criteria contained in this section of the law. If it is determined that the action could result in a significant environmental impact, then the preparation of an environmental impact statement (EIS) would be required.

D. ***Flood Damage Control - Chapter 125***

In 1968, the Federal Government enacted the National Flood Insurance Act to provide flood insurance protection to property owners in flood-prone areas (TOB Code, September 6, 1988). In response to this legislation, the Federal Emergency Management Agency (FEMA) developed a series of flood insurance rate maps (Firms) for all coastal communities, which indicate the boundaries of flood plains and identify flood elevations.

These maps delineate areas of special flood hazards (A-zones or the 100 year flood plain) and coastal high-hazard areas (V-zones, which are areas with special flood hazards associated with high-velocity waters generated by tidal surges and hurricane wave wash).

As described in Section 4.4.1, the Town of Babylon participates in the National Flood Insurance Program. In accordance with the FEMA requirements, the Town adopted Chapter 125 of the Town Code (the Flood Damage Control Law). This law contains construction standards for all development or redevelopment in A-zones and V-zones. The standards contained in Chapter 125 are designed to minimize property damage caused by flooding and erosion, and to promote public health and safety.

Chapter 125 imposes strict standards which apply to new construction or substantial improvement to existing structures in designated flood areas, where "substantial improvement" generally includes any project that involves repair, reconstruction, or improvement that either costs 50 percent or more of the replacement value of the structure, or entails an increase of 25 percent or more in the total square footage of the structure. All building permit applications must be reviewed by the Buildings Division of the Department of Planning and Development to insure compliance with the provisions of this law.

E. ***Coastal Erosion Hazard Areas - Chapter 99***

As discussed in Section 4.4.1, in accordance with Article 34 of the New York State Environmental Conservation Law (ECL), the Town of Babylon adopted the Coastal Erosion Hazard Areas law (TOB Code, May 2, 1989). This law establishes standards and administrative enforcement requirements that serve to minimize or prevent damage to property and natural resources from flooding and erosion resulting from inappropriate human activities in the coastal zone.

The coastal erosion hazard area (CEHA), in the Town of Babylon is identified on maps prepared by NYSDEC. The CEHA is defined as those land and/or water areas which contain natural protective features (such as bluffs, dunes, beaches, nearshore areas, or wetlands) and those areas which are located landward of natural protective features where the shoreline is receding at a long-term rate of one foot or more per year (structural hazard areas). A coastal erosion management permit must be obtained from the Town of Babylon for each action that involves development, redevelopment, new construction of erosion protection structures, public investment, or other land use activities within the CEHA. Dredging, excavating, and mining are prohibited in the nearshore zone, and on beaches and primary dunes located within the designated area. Vehicular and pedestrian travel in coastal erosion hazard areas is also restricted.

F. ***Freshwater Wetlands - Chapter 128***

The freshwater wetlands located in the Town of Babylon are considered invaluable resources for flood protection, wildlife habitat, open space and water resources. To preserve, protect, and conserve freshwater wetlands and the benefits derived therefrom, the Town enacted Chapter 128 (TOB Code, August 30, 1976). This law, which was adopted pursuant to ECL Article 24 (the New York State Freshwater Wetlands Law), is directed at preventing the despoliation and destruction of freshwater wetlands and regulates the development of such areas to preserve their natural capabilities.

Any regulated activity conducted on a wetland or in the 100-foot wide area adjacent to the wetland requires a permit from the Babylon Town Department of Environmental Control. Regulated activities, as defined under Chapter 128, include: draining, dredging, and excavation; dumping and filling; the erecting of roads or structures, the driving of piles, or placing of any other obstructions; any form of pollution, including but not limited to installing a septic tank, running a sewer outfall, discharging sewage treatment effluent or any other liquid wastes into a freshwater wetland; any subdivision of land; and any activity which substantially impairs any of the several functions served by freshwater wetlands.

The Town of Babylon Department of Environmental Control (TOBDEC) staff, who are responsible for enforcing Chapter 128, have not been certified by the State to delineate freshwater wetland boundaries. In cases where a boundary must be clearly defined, the TOBDEC will require that the permit applicant or other involved party have the NYSDEC accurately delineate this boundary. Although there is a formal mechanism by which the State can impart wetlands delineation authority to the Town, it is preferred that the State undertake such efforts as they possess the necessary expertise required for such matters.

6.3.2 NEW YORK STATE RESTRICTIONS

In addition to the Town of Babylon laws, there are certain New York State Environmental Conservation Laws (ECL) that effect development activities in the study area. These laws, which are enforced by NYSDEC include the following.

A. ***Tidal Wetlands Act - ECL Article 25***

The Tidal Wetlands regulations were enacted to preserve, protect, and enhance the present and potential values of tidal wetlands (NYSDEC, August 1977). Tidal wetlands are beneficial areas for marine food production. They provide wildlife habitat, control flooding associated with storms and hurricanes, and absorb silt and organic material. In addition, they provide opportunities for research and education. Areas adjacent to tidal wetlands also share some of these values. In general, tidal wetlands consist of all the tidal waters of the State, and the tidal marshes, flats and shoreline areas to a depth of 6 feet below mean low water.

To ensure that land use and development actions proposed for areas of tidal wetlands are consistent with the intent of ECL Article 25, a permit program was established to regulate almost every activity which would alter wetlands or their adjacent areas. Article 25 imposes a 75-foot setback for development and restricts activities in the adjacent area, which is defined as the narrowest of the following: the 300-foot wide area landward of the designated wetland boundary; up to the seaward edge of pre-existing man-made structures; up to the elevation contour of 10 feet above mean sea level; or up to the crest of a cliff or bluff. Additionally, on-site septic systems must be located a minimum distance of 100 feet from an adjacent wetland. Activities requiring a permit include: the construction, reconstruction and/or expansion of structures such as residences and other buildings; boat ramps or slips; docks, piers, wharves, or boardwalks; groins, jetties, or breakwaters; bulkheads, seawalls, retaining walls, rip rap, or gabions; septic systems; and roads, driveways, parking lots, bridges, and drainage structures. The movement of earth, including filling, dredging, dune building, beach nourishment, clearing and/or clearcutting, excavating, and grading, and the subdivision of land also requires a permit issued by NYSDEC. NYSDEC monitors compliance with the provisions of Article 25 and is responsible for enforcement actions.

B. ***Removal of Protected Plants - ECL Article 9 - 1503***

Section 1503 of ECL Article 9 (September 3, 1974) prohibits the removal of designated protected plant species, which include endangered species (those in danger of extinction), threatened species (those likely to become endangered within the foreseeable future), rare species (small populations within their ranges in the state), and exploitably vulnerable species (those likely to become threatened in the foreseeable future). Pursuant to this law, no person shall, in any area designated by the list or lists, knowingly remove or damage through the applications of herbicides or defoliants, any protected plant without the consent of the owner. Violations to this law are subject to enforcement action by NYSDEC.

C. ***Endangered and Threatened Species - ECL Article 11 - 0535 and 0536***

Section 0535 of Article 11 (1972) prohibits the taking, importation, transportation, possession or sale of any endangered or threatened species of fish, shellfish, crustacea or wildlife, or hides or other parts thereof, unless a license or permit has been issued by NYSDEC. Under this law, endangered species are defined as those species of fish, shellfish, crustacea or wildlife seriously threatened with extinction. Threatened species are defined as those species of fish or wildlife which are likely to become endangered within the foreseeable future.

Section 0535 of Article 11 enables New York State to enforce the endangered and threatened species lists maintained by the U.S. Department of the Interior as well as lists assembled by the State. Dissatisfaction with the Federal listing in the late 1960's brought about the enactment of the State list which affords more inclusive protection for New York State's endangered species.

In addition to the ECL articles which protect endangered, threatened, and rare plant and animal species, NYSDEC enforces certain policies to protect wildlife. For example, it is the policy of the State to protect the habitat required by a particular species to survive. To this end, NYSDEC will regulate bird nesting areas adjacent to development to ensure the continuation and breeding abilities of threatened and endangered bird species. NYSDEC will withhold permits in some cases until their particular concerns in this regard are specifically addressed.

6.3.3 OTHER APPLICABLE GOVERNMENT REGULATIONS

The Suffolk County Department of Health Services (SCDHS) regulates waste disposal and water supply management through various Suffolk County Sanitary Codes and Standards (SCDHS, 1985). The three most relevant articles are summarized as follows:

A. ***Article 4 - Water Supply***

This article protects potable water supplies from actual or potential sources of contamination. Any new installation or modification to an existing water supply system requires a permit from the SCDHS and must comply with minimum setback requirements with respect to well locations. The plans must meet the design standards of the SCDHS, and approvals must be received both prior to the construction, and prior to the operation of the water supply system. Article 4 requirements are discussed in greater detail in Section 3.2.

B. ***Article 6 - Realty Subdivision, Developments and Other Construction Projects***

This article sets for the requirements for sewage collection and treatment facilities, and water supply facilities for subdivisions and other developments. The requirements vary based upon the type of development proposed, the hydrogeologic zone in which the project is located, and the proposed lot size.

Article 6 stipulates that conventional septic tank/leaching pool systems may be approved for construction in residential developments not presently serviced by municipal sewerage systems, and where lot sizes are no smaller than 40,000 square feet in hydrogeologic zones III, V, and VI, or no smaller than 20,000 square feet in other hydrogeologic zones. Any other combination of land use, type of discharge, and location will require a more complex and integrated method of sewage collection, treatment and disposal. In addition, separation standards have been developed requiring a minimum of 75 feet between septic systems and water supply systems. Septic systems must also be setback 100 feet from nearby surface waters. See Section 3.1 for a more detailed discussion of hydrogeologic zones and other aspects of groundwater management in Suffolk County.

C. ***Article 12 - Toxic and Hazardous Materials Storage and Handling Controls***

This article specifies the storage and handling requirements for toxic and hazardous materials. Standards are provided for the design of aboveground and underground storage facilities, and for the development of time schedules for testing tanks for leakage.

6.3.4 LEGAL RESTRICTIONS CONTAINED IN THE LEASEHOLD AGREEMENTS

As discussed in Section 6.1, the study area communities were established on land owned by the Town of Babylon. These lands are leased by the Town to residential tenants. Three of the six communities are operated by non-profit community associations i.e., the West Gilgo Beach Association, the Great South Bay Isles Association (Oak Island), and the Oak Island Beach Association (Oak Beach Association). In the unassociated areas, the Town, as landlord, leases the improved residential lots directly to individual tenants (residents). In the associated areas, the Town negotiates master leases with the community associations. The associations, in turn, act as landlord and lease improved residential lots to individual tenants through sublease agreements.

The community associations uphold the subleases as well as oversee the use of properties, property development, the use and maintenance of common land, sublease transfers, and the day-to-day operation of their respective communities. In the unassociated areas, the Town oversees the technical and administrative terms of the leases.

Aside from the standard text, each lease and sublease agreement contains clauses that pertain to the use and development of the specific community to which it applies (Master Lease Agreement/Lease Agreement/Sublease Agreement; August 14, 1990). In addition, the sublease agreements for the associated communities indicate that the subleases are subject to the terms and conditions of the By-Laws and Rules and Regulations established by the respective community association. These By-Laws and their Rules and Regulations place additional restrictions on the residents of the communities to which they apply, similar to those of a homeowners' association. Therefore, in addition to complying with the terms and conditions of the sublease agreements, residents must also obey and acknowledge the requirements and restrictions set forth in their By-Laws and Rules and Regulations.

The leases and subleases contain a rent rider which specifies the annual rent schedule for the period commencing January 1, 1991 through the year 2050. Presently, the study area communities do not pay equal lease fee amounts, as over the past years each community has individually negotiated the specific terms of their leasehold agreements. When the leases were extended in August of 1990 (as discussed in Section 1.1), this rent rider was revised to reflect the newly established fee structure. Under the terms of the new agreement, by the year 2010 all the study area communities will pay the same rent, which will increase at the same rate for each community over the following forty year period. Oak Island, which is a permanent seasonal community, pays half the rental assessment of the year-round communities. The rent riders for the six communities are included in Appendix E. The tenant is also responsible for paying on time all taxes assessed against the property and improvements made thereon. In the event of failure to pay taxes on time, taxes will become "added rent" payable as rent to the landlord under the terms of the lease.

The lease/sublease agreements restrict the use of the property to single, private one-family dwellings for residential use only and for no other purpose. The premises may not be utilized for any trade, business or profession of any kind. No boat used in connection with a residence may be inhabited or used as living quarters. The leased lots are also not intended for use as speculative investment properties or for income producing purposes. For justifiable reasons, the landlord may permit the subletting of the premises as a single family dwelling but this activity is limited to not more than two out of four years in any consecutive four year period. In associated areas, additional restrictions on subletting may be imposed. The tenant may not sublet the premises or permit anyone to use the premise without first obtaining the landlord's consent.

A tenant may assign and transfer their lease or sublease in connection with the sale of their home. They may also assign and transfer the lease or sublease agreement by survivorship or by gift, will, intestate descent and distribution, or trust. When a lease is transferred through the sale of the property, the tenant must pay a lease transfer fee to the Town of Babylon equal to three percent of the first $200,000 of consideration and five percent on any consideration in excess of $200,000. The Town reserves first right of refusal on all lease transfers for which a transfer fee applies. In the event the transfer is to occur in an associated community, the community association is empowered to review the lease transfer prior to Town action on the matter.

The tenant is responsible for maintaining the property, including the construction and maintenance of bulkheads (if located on a waterway), walkways, boardwalks and sanitary systems, and for securing all necessary utility services. The resident may not disturb or alter the existing topography of the lot without the landlord's consent. The lease also requires that in the event the existing dwelling is destroyed or substantially damaged, the tenant shall promptly rebuild it in accordance with all applicable government regulations. Should the dwelling be destroyed or damaged during the last five years of the lease term, and the Town as senior landlord chooses not to extend the lease for a minimum of 20 years, the tenant has the option to surrender and cancel the lease effective the day the damage or destruction occurred.

The leases afford public access to Town of Babylon residents. Unless otherwise specified in a community's lease, streets and walkways shall be subject to free access and shall be available to the public at all reasonable times. Town residents shall have access to Town beaches, including beaches that front upon or are included within leased properties, so long as access is obtained by way of a public street or walkway. Free access shall be permitted to the public at all times to use the entire ocean beachfront.

Tenants must assume all risk from fire, flood, erosion and the elements and governmental interference. The leases indicate that the landlord does not guarantee to provide access to leased properties, in the event of interruption by storms, seas or other natural causes. If access to a property is permanently disrupted, the tenant may cancel the lease. The landlord may also make insubstantial changes in the property lines of the lots to reflect changes wrought by action of the ocean or bay, erosion or accretion, or for street realignments, without effecting a reduction in rent.

The tenant may remove the structures they own in accordance with the terms of the lease, as specified in Section 8.0 of this report. Furthermore, the lease/sublease agreement gives the landlord the right to remedy defaults in the event the tenant should fail to carry out the terms contained therein. Any cancellation of a lease or sublease by the landlord or the tenant requires a 30-day notice.

6.4 NEW YORK STATE COASTAL ZONE MANAGEMENT PROGRAM

6.4.1 GENERAL PROGRAM DESCRIPTION

In 1972, Congress passed the Coastal Zone Management Act (CZMA) in direct response to the widespread occurrence of inappropriate shoreline development and use of coastal resources. The CZMA and its subsequent amendments (1976, 1980, 1986 and 1990) affirmed a national interest in the effective protection and careful use of the coastal zone, calling for a balance between development and environmental protection (NYSDOS, 1988). This act provided financial and technical assistance to coastal states to voluntarily develop and implement management programs for their coastal areas. Pursuant to the CZMA, the Federal government established guidelines and requirements to provide the necessary framework and direction for the creation of coastal management programs on a state level.

In response to the CZMA, and in an effort to address statewide coastal problems and provide a means of solving these problems, the New York State Department of State (NYSDOS) prepared (and currently administers) a statewide Coastal Management Program (CMP). During the development of this program it was found that legislation was required to: 1) provide a method to accomplish coastal management objectives through the coordination of existing programs; 2) develop a consensus among all levels of government and the private sector concerning the means of achieving these coastal management objectives; and 3) establish enforceable policies for State and Federal actions undertaken within the coastal area. In 1981, the New York State Legislature enacted the Waterfront Revitalization and Coastal Resources Act (WRCRA - Article 42 of the Executive Law) to meet these requirements (NYSDOS, 1982). WRCRA established a balanced state-wide approach for encouraging development in coastal areas while providing for the protection of coastal resources. WRCRA defined the boundaries of the State's coastal area, within which the provisions of the CMP apply. WRCRA also provided a set of 44 policies which address important coastal issues.

The coastal policies, which represent the core of New York's Coastal Management Program, were derived from existing laws and regulations administered by state agencies. Although the NYSDOS is responsible for administering the overall CMP, many of the coastal policies are carried out by programs administered by other State agencies. For example, NYSDEC operates regulatory programs which provide protection to tidal and freshwater wetlands (Policy 44) and restrict development and other activities in flood and erosion hazard areas (Policies 11 through 16). Other coastal program policies are based upon the provisions of WRCRA - Article 42. These policies carry out the intention of the State Legislature that there be a "balance between economic development and preservation that will permit the beneficial use of coastal resources while preventing the loss of living marine resources and wildlife, diminution of open space areas or public access to the waterfront, shoreline erosion, impairment of scenic beauty, or permanent adverse changes to ecological systems" (Executive Law, Section 912(1).

The 44 coastal policy statements, their attendant guidelines, and existing federal and state environmental and resource management laws provide the objectives and standards for the CMP. NYSDOS implementation of the coastal program is effected through three program components -- Local Waterfront Revitalization Programs, review of federal and state government actions for consistency with the policies, and the advocacy of projects and activities which implement specific coastal policies.

A. ***Local Waterfront Revitalization Programs***

The Local Waterfront Revitalization Program (LWRP) was established to enable the State's Coastal Management Program to address the problems of coastal development in full partnership with local government (NYSDOS, August 1989). Management of coastal development, whether the concern is protecting critical resources or revitalizing deteriorated waterfronts, must, of necessity, include regulation of land use decisions. While the State through its various permit programs and capital projects has a major impact on development patterns, local governments have the primary authority for directly regulating land use.

The LWRP refines and supplements the State CMP by incorporating local needs and objectives. As authorized by the Waterfront Revitalization and Coastal Resources Act, an LWRP is a locally prepared, detailed land use plan that sets forth design, locational, and environmental standards for all development along the municipality's waterfront. It also describes capital projects and other actions necessary to further State and municipal policies for the waterfront. Federal and State law provide that all government agencies when undertaking any direct, funding, and permit action, must adhere to the policies of an approved LWRP.

B. ***Consistency***

The federal Coastal Zone Management Act stipulates that federal agency activities affecting land and water uses within the coastal area must be consistent with approved state coastal management programs. This requirement means that no federal financial assistance to state or local governments can be provided, unless the direct action, permit or grant is in accordance with the state's coastal program. In general, NYSDOS reviews all federal actions to determine consistency with the State CMP. In this way, New York State has control over the actions of federal agencies that affect its coastal area.

Like their federal counterparts, State agencies operate a number of programs which affect the use and protection of coastal resources. In recognition of both the beneficial and potentially adverse affects that State agency activities may have upon waterfront areas, WRCRA requires that "actions directly undertaken by State agencies within the coastal area... shall be consistent with the coastal area policies of this Article". This provision of law ties together the programs of State agencies by binding their decision-making actions to the coastal policies. NYSDOS reviews State agency actions, but each agency makes its own determination of consistency. Actions which are not consistent with applicable policies cannot be undertaken or, where appropriate, must be modified so that they will be consistent.

C. ***Advocacy***

The consistency provision of the coastal program and the existence of Local Waterfront Revitalization Programs assures that many coastal policies are implemented. In addition, policies must also be advanced by the State's direct involvement in a variety of coastal programs, projects, and activities. Hence, advocacy of the coastal policies is a major focus of the CMP. Included within this focus are efforts to promote the State's commercial fishing industry; provide suitable space for traditional maritime activities; preserve coastal historic, scenic and cultural resources; promote public access to coastal lands and waters; minimize development in coastal flooding and erosion hazard areas; protect significant coastal fish and wildlife habitats; and seek solutions to the problems that constrain port and harbor dredging.

6.4.2 COASTAL MANAGEMENT CONTROLS IN THE STUDY AREA

At present the Town of Babylon does not have a state-approved Local Waterfront Revitalization Program. Although the Town prepared a draft LWRP in November of 1986, this program was never officially adopted. In the absence of an approved local program, enforcement of the 44 coastal policies embodied in the State CMP remains under the authority of the New York State Department of State.

NYSDOS is responsible for the review of all Federal and State agency actions proposed within the coastal boundaries of the Town, which includes the entire study area. Actions reviewed by the State include the construction of bulkheads and marinas, dredging, the disturbance of tidal or freshwater wetlands, residential and commercial waterfront developments, and the reconstruction of existing bridges and highways.

When a federal or state project is proposed within the coastal zone, a coastal assessment form must be prepared and submitted to NYSDOS to initiate the CMP review process. Importantly, consistency review does not extend to any project that does not require some form of state or federal approval which would trigger the review process. Because the Town of Babylon does not have an approved LWRP, the Town Department of Environmental Control does not require project applicants to complete a coastal consistency form as a part of the preparation of a building permit application or an environmental assessment form.

6.5 ANALYSIS OF DEVELOPMENT PATTERNS IN THE STUDY AREA

This section of the report analyzes the present and anticipated future development patterns in the study area. Emphasis has been placed on the degree to which land use activities comply with the existing regulations that govern development. An assessment of the vacant lots in the communities was also undertaken to determine the potential for future development.

6.5.1 COMPLIANCE OF DEVELOPMENT IN THE STUDY AREA WITH EXISTING REGULATIONS

A. ***Zoning Restrictions***

As stated in Section 6.3.1, the study area is zoned B-Residence. This zoning classification requires a minimum lot size of 10,000 square feet. Lots in the study area range in size from just under 6,000 square feet in Oak Beach to over an acre on Oak Island (Table 6-4). This is due primarily to the fact that most of the structures in the study area were constructed on lots that were subdivided prior to the effective date of the Town zoning requirements (July 1954). The West Gilgo Beach and Gilgo Beach communities, and most of the homes in the Oak Beach communities, do not meet the minimum lot size requirement. In addition, most of the homes situated in these areas do not meet the minimum setback or lot width requirements. Therefore, the lots that do not meet the current zoning requirements are considered non-conforming under the requirements. However, development or redevelopment of already improved properties is generally permitted, provided that the action conforms to the maximum extent possible to zoning requirements and other applicable regulations currently in effect (Falasco, TOB, November 16, 1992). All building permit applications are subject to Town departmental review and, because of their non-conforming status, to Town Board approval.

B. ***Environmental Quality Review***

Building permit applications are reviewed by the Division of Buildings, in the Department of Planning and Development, for compliance with applicable Suffolk County Board of Health, Town Zoning, New York State Building Code, NYSDEC, FEMA and U.S. Army Corps of Engineers requirements. The application, along with the findings and recommendations of the Division of Buildings, is subsequently forwarded to the Department of Environmental Control for environmental review in accordance with the TOBEQRA provisions (Chapter 114 of the Town Code). Based on that review, an action is classified as a Type I, Type II, exempt or unlisted. The SEQRA status, as well as the Environmental Control Department's site plan recommendations on the application, are returned to the Planning Department for further action. If the action is classified as a Type I action, a coordinated review must be undertaken, whereby all involved agencies are required to issue comments and recommendations necessary for determining the significance of the action. Type I actions are more likely to require the preparation of an EIS than unlisted actions. A coordinated review is optional for unlisted actions.

Section 11 of Chapter 114 of the Town Code (The Environmental Quality Review law), contains a listing of actions that have been classified as Type I. There are a number of items on this listing that apply to actions that may be proposed in the study area. These include:

- The sale, lease, annexation or other transfer of Town-owned lands which are permanently or intermittently flooded;

- The construction or reconstruction of any building exceeding thirty-five feet above original ground level;

- Any unlisted action which takes place on land designated by the State as a Significant Coastal Fish and Wildlife Habitat (Captree Island and Oak Island);

- Any major addition (as defined in Chapter 99 of the Town Code) to a structure located within the boundary of the coastal erosion hazard area;

- Any action involving the dredging of a new navigation channel;

- The expansion, by more than twenty-five percent of the existing gross floor area, of any building located on land leased by the Town on Oak Island, Captree Island, West Gilgo Beach, Gilgo Beach, Oak Beach and Oak Beach Association (unless determined to be a Type II action);

- The issuance of new leases and/or subleases on undeveloped lands on Oak Island, Captree Island, West Gilgo Beach, Gilgo Beach, Oak Beach and Oak Beach Association; and

- The sale of Town-owned lands on the barrier beach.

Any action on this list that is proposed in the study area would be classified by the Town as a Type I action, which requires the preparation of a long environmental assessment form (EAF). Upon review of the EAF, an environmental impact statement would also be required if the action was determined to have significant environmental impacts.

As previously discussed, when any action is proposed in the study area, it is subject to Town agency review and must receive Town Board approval. To eliminate the need for every action, no matter how minor, to go before the Town Board for approval, the Department of Planning and Development is considering the establishment of a set of guidelines or "thresholds" for review purposes, whereby only proposed projects which exceed these thresholds would require approval from the Town Board. Streamlining of the review process in this manner could reduce the time involved in receiving approval for many projects and would also help to reduce the number of routine actions requiring consideration by the Town Board. If this amended review procedure is implemented, Planning and Development (with the review assistance of the Department of Environmental Control) could grant approval and issue the necessary permits required for such projects as the construction or reconstruction of sheds and decks, or other minor interior or exterior home improvements.

C. *Other Environmental Restrictions*

When a building permit application is reviewed by the Planning and Environmental Control Departments, compliance of the proposed action with the Town Flood Damage Law (Chapter 125), Coastal Erosion Hazard Areas Law (Chapter 99), and Freshwater Wetlands Law (Chapter 128) is assessed. Development and redevelopment in a designated flood zone must be undertaken in accordance with the required elevation standards, whereby the first floor elevation meets or exceeds the established standard. Development or redevelopment proposed in a coastal erosion hazard area must comply with the standards contained in the CEHA law and the proper permit must be secured. Additionally, any development or redevelopment proposed within 100 feet of a designated freshwater wetland requires a wetland permit issued by the Town prior to commencement of the project. If the location of the wetlands boundary is called into question, the TOBDEC would require the applicant to have NYSDEC accurately delineate this boundary. The development restrictions of Chapters 99, 125, and 128 are discussed in greater detail in Section 4.4.1 of this report.

The majority of the homes in the study area were constructed prior to enactment of current environmental regulations. With respect to flooding and erosion legislation, the Flood Damage Law (Chapter 125) and the Coastal Erosion Hazard Areas Law (Chapter 99) were adopted by the Town of Babylon in September of 1988 and May of 1989, respectively. Consequently, very few of the homes in the study area were built in compliance with these regulations. As discussed in Section 4.3.1, Cashin Associates conducted a survey of the base flood elevations in the study area for this report. This survey indicated that of the 336± homes located in the V-Zone, a maximum of 18 (or five percent) comply with all of the FEMA construction standards. However, as these homes are expanded, upgraded, or replaced over time, they will be required to comply with FEMA regulations.

Similarly, most of the homes in the study area pre-date the Town freshwater and State tidal wetlands regulations. The Town law was adopted in August of 1976; the State legislation was enacted in 1977. When the homes in the study area were built (or in some cases relocated to the area), particularly in the Gilgo Beach, West Gilgo Beach, Oak Island and Captree communities, they were either constructed directly in wetland areas or fill was placed on the wetlands to provide a base for development. These early development practices and their impacts on the wetlands ecology are discussed in greater detail in Section 5.1.1 of this report.

Development in the study area also was generally undertaken prior to the adoption of the Suffolk County Sanitary Code, which was established in 1985. As a result, the majority of the homes do not comply with the standards established under these laws. Article 6 of the Sanitary Code establishes minimum lot size requirements for homes with septic tank and leaching pool systems. In accordance with these requirements, because the study area is located in Hydrogeologic Zone VII, new houses with septic systems must be sited on lots that are 20,000 square feet or larger. As shown in Table 6-4, many of the homes are built on lots that do not meet this requirement.

In addition, Articles 4 and 6 require minimum separation distances between surface waters, water supply wells, and septic systems, (NYSDEC regulations specify separation distances between tidal wetlands and septic systems). These separation requirements are discussed in Sections 2.3, 3.2 and 3.3. Suffolk County regulations also require that individual on-site septic systems be located a minimum of two feet above the groundwater table. It is apparent that most systems in the study area do not meet these requirements.

In an effort to correct substandard conditions, Suffolk County Department of Health Services (SCDHS) is requiring that existing violations be upgraded when a property is redeveloped. Any building expansion of 25 percent or more requires the submission of a site plan and survey to the SCDHS for review. These plans must show the present location of the septic system and water supply on the subject property and on adjacent properties. The SCDHS requires that substandard systems be brought up to code and/or replaced with alternative technologies. Wherever possible, setback violations must also be corrected.

6.5.2 ASSESSMENT OF DEVELOPMENT OF VACANT LOTS IN THE STUDY AREA

A. *Methodology Used for Determination of Development Potential*

As discussed in Section 6.2.2, vacant land in the study area includes large tracts of undeveloped open space on the barrier island, undeveloped marsh islands, and individual vacant lots and areas located within the residential communities. Utilizing information collected during the Cashin Associates (CA) field survey of the residential communities, the development potential of the individual vacant lots was assessed. Although it is presently the policy of the Town not to grant any new leases in the study area for additional residential development, there were two objectives for undertaking this assessment of development potential: first, to determine the overall potential for community growth and the associated impacts of additional residential development in the event the Town chose to continue the general leasing of lots in the study area; second, to determine which lots would be suitable for use in the event the Town decided to relocate existing homes or permit current residents to rebuild in other areas of the communities as the result of a catastrophic storm event. The issuance of any new leases or subleases for the use of undeveloped Town-owned land in the study area is a Type I action, subject to full environmental review and Town Board approval.

The Suffolk County tax maps, the Town of Babylon lot maps, and recent aerial photography were used to identify vacant lots in the study area.

(The Suffolk County tax maps for the study area are included in Appendix E). Several environmental constraints were established as the criteria utilized to determine the suitability of each vacant lot for future development. These include the location of the parcel with respect to flood boundaries and coastal erosion hazard area boundaries; whether the parcel contains or is adjacent to a tidal or freshwater wetland; proximity of the parcel to critical wildlife habitat or bird nesting areas; size of the parcel; and other land use-related conflicts such as the use of the parcel for road access or drainage. In addition to the field analysis, a development potential study prepared by the Town of Babylon Department of Environmental Control (December 1988) was reviewed as a possible source of supplemental information.

It should be noted that when analyzing the development potential of existing vacant properties, the size of these properties was considered with regard to the average lot size within the surrounding community. Although the minimum lot size required by the B-Residential zoning is 10,000 square feet, if the majority of the surrounding development has been established on lots smaller than 10,000 square feet (which is the case in many of the communities) then smaller vacant lots in these areas were considered potentially developable assuming there were no other environmental constraints. This decision is based on the fact that the development of these lots would be consistent with surrounding land use patterns, and because the Town has granted approval for the redevelopment of residences that are located on lots in these areas that do not meet the minimum lot size standards.

Development potential was assessed for both the vacant Suffolk County tax map lots and the vacant Town of Babylon (TOB) lots. With the exception of an area in the West Gilgo Beach community, the SCTM and TOB lots are positioned in identical locations. In some places, a single County lot encompasses several TOB lots. For example, SCTM lot No. 65 in the western section of West Gilgo Beach, which measures 75 feet by 900 feet, encompasses TOB lots 35, 37, 39, 41, 43, 45, 47, 49, and 51 (each of which measures 75 feet by 100 feet). Appendix E contains an index of lot designations, which correlates the SCTM lots with the corresponding TOB lots.

The examination of the vacant lots in each community revealed the potential to ultimately develop a total of 82 lots in the study area (see Plates 3A to 3G and Appendix E). This includes: 15 existing SCTM lots that could each accommodate the development of one structure; three existing SCTM lots that would require subdivision to provide a total of 18 individual lots; five SCTM lots that would require either site engineering for utilization (4 lots which require drainage improvements) or do not meet the minimum lot size requirement and do not conform with the size of surrounding lots (1 lot); and 44 lots that would require official mapping and subdivision (41 of these lots exist only on the Town of Babylon lot maps and 3 are located in an area deemed suitable for development based on CA's analysis of vacant land in the study area). If only the existing vacant SCTM lots are considered, then 38 lots could be potentially developed. This includes the three larger SCTM lots that would require subdivision to provide a total of 18 individual lots and the 5 SCTM lots that are subject to additional development considerations. If no subdivision were to take place, then a total of 20 SCTM lots could be developed.

The 82 existing and potential vacant lots are located in three of the six study area communities: West Gilgo Beach, which contains 47 lots; Gilgo Beach, which contains 17 lots; and Oak Beach Association, which contains the remaining 18 lots. See the following subsections for a discussion of the development potential in each of these three communities. The other communities (Oak Island, Oak Beach and Captree) all contain vacant lots, but none were considered suitable for development (See Table 6-1 in Section 6.2.2).

B. ***West Gilgo Beach***

Vacant land in the West Gilgo Beach community consist of 3 SCTM lots and 41 TOB lots (Plate 3A). Of the three SCTM lots two are individual building lots and the other (Lot 91) is large enough to be subdivided into 13 individual building lots. However, only 4 of these are considered to be suitable for development; the remaining 9 lots contain freshwater wetlands. The subdivision of these lots would require approval from the Town Board as well as full environmental review. The 41 TOB lots are located in an area that would require official filing with the Suffolk County Clerk's office because these lots are not shown on the County tax maps. These lots have been included in this analysis more for the purposes of relocation in the event of major storm damage or destruction, rather than for expanded development within the study area.

Ten of the 47 potentially developable lots are located within the 100-foot adjacent area of a Town-regulated freshwater wetland. The development of these lots would require site plan review by the Department of Environmental Control and the issuance of a wetlands permit in accordance with Chapter 128 of the Town Code.

The vacant properties in the West Gilgo Beach community are bisected by the flood zone boundary. Some of the potentially developable vacant lots are located in the V11 flood zone, which has a base flood elevation of 12 feet. The base flood elevation is the height in relation to mean sea level expected to be reached by the waters of the base flood at pertinent points in the flood plain of coastal areas. Other vacant parcels, which are situated closer to the bay, are located in the V6 flood zone, which has a base flood elevation of 9 feet. Structures that are erected on these properties must have the habitable floor area located a minimum of 12 or 9 feet above mean sea level, depending on the location of the property. The construction of the properties must also comply with other standards contained in Chapter 125 of the Town Code.

Of the 47 potentially developable lots, 35 would necessitate the provision of access roads. The construction of common access driveways, extending north from Ocean Walk, would be required.

This access requirement and the need to construct access driveways is not seen as a significant constraint to development.

Some of the land situated north of Ocean Walk contains areas of secondary dunes. These lots are considered to be more appropriate as potential relocation sites than as sites for expanded development. The significance of these secondary dunes has been greatly diminished by the construction of Ocean Parkway and the housing along Ocean Walk in the West Gilgo Beach area. Therefore, they are not considered to be of significant value with respect to the development of this area. Additionally, they were not found to be of great ecological significance to resident and migratory wildlife species. This area is not within the coastal erosion hazard area boundary and is therefore not regulated under Chapter 99 of the Town Code. Aside from the land clearing permit required pursuant to Chapter 213, Sections 369 through 373, there are no existing regulations that would affect development in these dune areas. It should be noted that the land clearing permit mentioned above would be required prior to the development of any of the developable vacant lots in the West Gilgo Beach area, as well as the Gilgo Beach and Oak Beach Association communities.

C. ***Gilgo Beach West***

The vacant lots in the Gilgo Beach community include all of SCTM lot 65 and part of SCTM lot 12 in Gilgo Beach West (Plate 3B). SCTM lot 65 encompasses 9 TOB lots, which each measure 75 feet by 100 feet. The portion of SCTM lot 12 that appears to be suitable for development contains 5 TOB lots, each measuring 75 feet by 100 feet. These 14 lots are equal in size to the existing lots which have been developed in this area. The remaining three TOB lots that comprise lot 12 either contain areas of tidal wetlands or are less than 50 feet from the wetland boundary, and are therefore not considered suitable for development. Access could be provided to this area through the extension of the existing internal roadway.

Since 12 of these lots comprise all or portions of two Suffolk County tax lots, they would require subdivision prior to development. The subdivision of these undeveloped lots would be a Type I action, subject to TOBEQRA review, and would require Town Board approval, as would the establishment of new tax lots in areas not previously mapped or subdivided.

The 12 potentially developable lots are located within the regulated 300-foot adjacent area of New York State-regulated tidal wetlands. However, none of the lots are less than 75 feet from the wetlands, so the development setback restriction does not apply. In any event, the development of these 12 lots would require NYSDEC review and approval.

The Gilgo Beach community is divided into two flood zones; the V11 zone, which has a base flood elevation of 12 feet; and the V6 zone, which has a base flood elevation of 9 feet. Of the 12 lots considered suitable for development (Plate 3B), the 9 lots located to the south, are in the V11 zone. The 5 lots located to the north are situated in the V6 zone. Therefore, future development in this area would have to comply with the requirements set forth in Chapter 125 of the Town Code, which regulates development in flood hazard areas.

One possible constraint to the future development of all or a portion of the lots to the west of the existing Gilgo Beach community is the presence of a known nesting area for the Northern Harrier. This raptor is a State-listed threatened species (as discussed in Section 5.2.1). If the Town was to seriously consider the utilization of this area for housing sites, it is recommended that a survey be undertaken beforehand to define the extent of potential disturbance. This survey should be conducted by a qualified wildlife biologist to determine if future development would infringe upon or disrupt the nesting activity of the Northern Harrier. The Town may also consider the designation of personnel from the Audubon Society or the Nature Conservancy to review subdivision or site plan submissions.

D. ***Gilgo Beach East***

At the eastern end of the Gilgo Beach community, there is a large area of vacant land. An assessment of this area indicated the potential for the development of three lots directly adjacent to the end of the existing housing (Plate 3B). This area was considered by CA to be potentially suitable for use as a relocation area for residents in the event of storm damages and destruction, rather than for general development purposes. This area has not been mapped by the Town of Babylon and would, therefore, require approval from the Town Board. The future leasing of this undeveloped area would also be a Type I action, subject to full environmental review.

The three potentially developable lots in Gilgo Beach East are located in a V11 zone, with a base flood elevation of 12 feet. They are also located in the 300-foot area adjacent to a State-designated tidal wetland. Development in this area would thus require approval from the Town and State, based upon review for compliance with the existing regulations. Access to these proposed properties could be provided through the easterly extension of the existing roadway.

E. ***Oak Beach Association***

The Oak Beach Association contains 36 vacant SCTM lots which are dispersed throughout the community (Plate 3G). However, only 18 SCTM lots in this area were considered to be suitable for development; the 18 other vacant parcels were either located in a coastal erosion hazard area, were too small to accommodate development, or contained wetlands. Of the 18 potentially developable lots, four are presently used for drainage purposes and would require some site engineering to enable effective utilization of the properties. These four lots, which are located in the northwest portion of the community, north of The Fairway, could be modified through site engineering so that the drainage, which is currently channeled onto these parcels, is collected and rerouted to adjacent vacant parcels located on the south side of The Fairway. These adjacent properties contain wetlands and/or are presently utilized for site drainage purposes and are not considered to be developable.

There is one other lot in the Oak Beach Association (SCTM lot 222) that appears to be suited for development but does not meet the minimum lot size requirement of 10,000 square feet. This lot, which is located at the eastern end of the community, measures approximately 75 feet by 100 feet (7,500 square feet). This lot is identified as a small or substandard lot because the surrounding properties all meet or exceed the required minimum lot size. After applying the required yard setbacks to this lot, a 1,350 square foot area remains, which is a large enough area to accommodate a house. Therefore, this parcel is considered as a potential developable lot.

All 18 potentially developable vacant lots in the Oak Beach Association community are located in the V8 flood zone. The V8 zone has a base flood elevation of 9 feet. Six of the eight vacant lots (SCTM lots 120, 122, 123, 124, 126 an 128) located north of The Fairway are partially located in the A6 zone, which has a base flood elevation of 8 feet. This flood zone boundary, however, extends across the northern one-third of these parcels and would not affect development. As previously mentioned, in cases where a property is bisected by a flood zone boundary, the more restrictive flood zone designation would apply. In any event any development that would occur on these 18 vacant properties, must be undertaken in compliance with the standards contained in Chapter 125 of the Town Code (the Flood Damage Law). Furthermore, the habitable floor area must be constructed no less than nine feet above mean sea level.

Eight of the eighteen potentially developable vacant lots (SCTM lots 130, 132, 136.2, 173, 178.3, 181, 184, and 222) are located within the 100-foot adjacent area of a freshwater wetland. Any construction activities that occur on these properties would be regulated under Chapter 128 of the Town Code and require a permit issued by the Department of Environmental Control.

Five lots (SCTM lots 178.3, 181, 206, 207, and 210) would require the provision of access, as none currently exists. In this regard, the construction of extensions to existing driveways would be required. Access is not seen as a constraining factor to the development of these lots.

6.6 ANALYSIS OF POTENTIAL DEVELOPMENT WITHIN THE STUDY AREA

This section contains an analysis of the impacts that would result from various scenarios of development within the study area. The discussion is organized in a fashion similar to what would typically be found in the alternatives section of an environmental impact statement (EIS), with the potential impacts of the various alternative development scenarios analyzed individually to facilitate comparison. The parameters of analysis used below are the same seven study elements that have been examined under existing conditions in Sections 2 through 9.

6.6.1 NO-BUILD

The no-build (no-action) scenario, which is a required element of an EIS, assesses the impacts that would result if the proposed action is not undertaken and the status quo is maintained. Since the no-build scenario investigates the consequences of preserving existing conditions, analysis of this alternative serves as an important basis for assessing the impacts of a proposed action.

In this study, the existing condition (i.e., the no-build scenario) is equivalent to the "proposed action", which has been intensively analyzed in the other sections of this report. Therefore, no further discussion of this topic is warranted here.

6.6.2 LEASE PHASE-OUT

The lease phase-out scenario, while currently not under consideration and unlikely due to economic factors (see Section 8), involves the termination of all the current residential leases that the Town of Babylon has granted on the Outer Beach, either by allowing the leases to expire at the end of their current term in 2050 or by prematurely terminating the leases prior to 2050. The existing houses would be removed from the community areas within one year of lease termination, and the land would be allowed to revert to a quasi-natural state. The vacated land would then be available for use in passive public recreational activities (e.g., hiking, picnicking, bicycling, educational activities, etc.), possibly mixed with some more active recreational uses (e.g., boat launching and dockage, fishing, etc.).

A. ***Surface Waters***

The minor impacts to surface water quality that are attributed to the existence of the subject communities (e.g., some septic overflow into adjacent surface waters during extreme high tides and severe storms, and the possible release of wastewater into the bay from water craft operated by community residents) would be eliminated by the removal of the subject houses from the Outer Beach. However, it is unlikely that this action would produce a measurable improvement in the water quality in the adjoining areas of Great South Bay.

Water quality along the southern shore of western Great South Bay is presently at acceptable levels for shellfish harvesting, except in the aftermath of severe storms. The removal of the Outer Beach homes and the termination of the use of substandard septic systems connected to some of these homes would be expected to decrease the amount of coliform bacteria carried into the bay by storm waves and extreme tides. However, the entire bay is plagued with deteriorated water quality following severe weather events, and, in fact, this problem is much more serious along the northern margin of the bay. Stormwater runoff from developed mainland areas is generally recognized as a major contributing factor causing water quality degradation in shallow coastal waters such as Great South Bay. Thus, the overall effect on surface water quality that would be effected by the elimination of septic discharge from the Outer Beach communities would be minimal.

The boat basins on the north side of the barrier island are closed to shellfish harvesting during the boating season as a precautionary measure due to the potential for contamination arising from vessel wastewater discharges. This policy applies to basins that are in undeveloped areas, as well as to docking areas that adjoin the subject communities. If the Outer Beach residences are phased out, it is expected that the Gilgo and West Gilgo basins would continue to be closed to shellfishing on a seasonal basis due to the potential use of these areas by transient vessels.

B. ***Groundwater***

The minor impacts to groundwater quality that are attributed to the existence of the subject communities (i.e., primarily the contamination of the upper freshwater lens by septic wastes and, perhaps, by other substances such as lawn and landscaping chemicals) would be eliminated by the removal of the subject houses from the Outer Beach. However, as discussed below, this action would not produce a significant improvement in the overall quality of the groundwater reservoir beneath the study area.

The surface layer of groundwater beneath the study area constitutes a lens of relatively young freshwater derived from recent rainfall. This shallow aquifer is characterized by rapid horizontal flow to the north and south, and discharge into the bay and ocean. The surface lens sits atop a salty groundwater unit, and is not hydraulically connected to the deeper aquifers (Magothy and Lloyd, which are the primary sources of drinking water for the region). Thus, wastes that are introduced into the surface groundwater layer in the study area do not affect the important, deeper portions of the aquifer.

The Suffolk County Department of Health Services (SCDHS) has expressed concern with regard to the potential impacts caused by the unregulated installation and abandonment of private deep wells. These wells, which are scattered throughout the study area, penetrate to the Magothy Aquifer through overlying units. The inevitable corrosion of the casing of these wells, caused by chemical interaction between the salty groundwater layer and the generally inferior materials of the casing, creates a conduit through which saltwater can descend to the fresh Magothy unit. Phasing-out residential development on the Outer Beach would ameliorate this problem by terminating the drilling of new private wells. However, adequate mitigation can be effected without eliminating the communities, by means of increased governmental regulation of the abandonment and installation of individual private wells. Governmental monitoring of the closure of these wells would prevent them from becoming a conduit for the downward migration of saltwater (and other contaminants). Oversight of the installation of new private wells would ensure that these wells meet minimum standards of construction, which would prolong their life and decrease the rate at which wells are abandoned in the future (see Section 3.5.2).

Phasing-out residential development in the study area would decrease the usage demand on the groundwater aquifer. Currently, it is estimated that water is withdrawn from the aquifer at an average rate of approximately 53,700 gallons per day for use in the subject residential communities (see Section 3.2.2). However, not all of this water is pumped from the deep aquifer, as many of the private wells in the study area tap into the shallow Upper Glacial zone.

C. ***Erosion Control and Flooding***

In general, the subject communities have not directly increased the susceptibility of the study area to erosion and storm-induced flooding. In fact, the elevation of the land surface through the placement of fill and the installation of shoreline protection structures associated with the communities have actually increased the degree of protection from the effects of storm surge and waves. However, because of the presence of homes on the Outer Beach, this area is highly susceptible to storm damage in terms of possible property casualty, injury, and loss of life. These potentially large impacts, which are briefly summarized below, would be eliminated by the removal of the subject houses from the Outer Beach.

Despite the relatively minor extent of recent storm-related damage that has occurred in the subject communities, the residences in the study area are generally considered to be vulnerable to severe storms. Furthermore, the overall degree of vulnerability has significantly increased of late, due to the loss of a substantial volume of material from essential protective features (i.e., the beach and dunes at Gilgo and West Gilgo Beaches, and the Sore Thumb) during recent storms.

As discussed in Sections 4.9.1 and 4.9.2, the potential for storm damage would increase significantly if there is a lapse in the maintenance of the primary protective features listed above. Although it appears to be unlikely that actions to protect the West Gilgo and Gilgo Beach shorelines would be abandoned in the foreseeable future, due to the overriding concerns with the structural integrity of Ocean Parkway and the possibility of the formation of a breach through this section of the barrier, a similar level of priority does not apply to the Sore Thumb. Since maintenance of the Sore Thumb would be undertaken for the more or less exclusive purpose of providing erosion protection to the residential shorefront at Oak Beach, the delay or abandonment of this project would be more likely than a similar lapse in the Gilgo beach and dune projects. Thus, in this sense, the Oak Beach communities are more susceptible to future erosion and storm damage than West Gilgo and Gilgo Beaches.

Depending upon the use that the Town would establish at Oak Beach in the event of a lease phase-out, it may be desirable to undertake maintenance work on the Sore Thumb. For example, an active public recreational facility at Oak Beach may become susceptible to costly damage if the protective capabilities of the Sore Thumb are allowed to deteriorate. On the other hand, a passive recreational facility which lacks structures that may be damaged by storms or erosion would not require repairs to the Sore Thumb.

Oak and Captree Islands are situated almost entirely within the A zone and, therefore, are much less vulnerable to storm wave damage and erosion than the four communities that are located on the barrier. However, as demonstrated by the extent of damage wreaked during recent storms, these two bay island developments are the most prone to recurrent flooding during severe storms. Thus, whereas the barrier island houses are exposed to the greatest potential damage during a single killer storm, the bay island houses are subject to more frequent moderate damage during less intense storms.

D. ***Interaction with Natural Systems***

Phasing-out of the subject communities would have an overall beneficial impact on native vegetation and wildlife by allowing areas that have been disturbed by residential development to revert gradually to a quasi-natural state. However, these developed areas comprise a relatively small portion of the total area of the Outer Beach. The four barrier island communities (i.e., West Gilgo Beach, Gilgo Beach, Oak Beach, and the Oak Beach Association) occupy 152 acres, or 6.9 percent, of the 2,194 acres of land in the Babylon Town portion of Jones Island, between the Oyster Bay town line to the west and the boundary of Captree State Park to the east (and approximately 3 percent of the ±5,000 acres on Jones Island as a whole). The two bay island communities (i.e., Oak Island and Captree Island) occupy 34 acres, or 1.5 percent, of the 2,282 acres of islands in the Town of Babylon portion of Great South Bay.

The developed portions of the study area comprise a variety of different vegetative zones, which provide habitat to varied communities of wildlife. The majority of the developed area has been situated upon fill material and, if abandoned and allowed to undergo natural vegetative succession, would revert to an upland habitat. Shrub thicket would invade these areas, which would benefit wildlife and avian species that thrive in this type of environment. In particular, songbirds and raptors, including the some protected species (e.g., eastern bluebird and grasshopper sparrow), would be expected to populate these areas.

Removal of the houses in the Oak Beach communities would allow waterfront land in these areas to revert to dune habitat, especially along the shoreline of the Oak Beach Association. Wildlife species that would benefit from this transition include foxes and deer. Populations of rodents (e.g., mice, voles, and rabbits) would also be expected to increase, which, in turn, would support greater numbers of predators.

Reversion of the Oak Beach shoreline to its natural state would also create additional habitat for certain protected shorebirds (e.g., piping plover, common tern, least tern, and roseate tern). These species select nesting sites that are characterized by fresh, unvegetated sands (dredge spoil areas are particularly attractive to these species), but are not tolerant of human presence.

Removal of the houses at Gilgo Beach East and along the eastern shoreline of Oak Island would allow the recovery of tidal wetland vegetation that has been disturbed by human activities in these areas. This transformation would create additional habitat for some avian species of special concern (e.g., black rail, least bittern, and short-eared owl).

E. ***Development Potential***

Phase-out of the subject leases would, obviously, render the issue of development potential moot. The implementation of this scenario would eliminate all existing residential development from the study area, and would prevent any presently vacant lands from being developed in the future.

F. ***Community Costs and Benefits***

Section 7.3 presents a monetary cost-benefit analysis of the use of the lands in the six Outer Beach communities for residential occupancy. That analysis, which considered only the day-to-day costs of community operations and both the direct and indirect generation of revenues, indicates that the Town of Babylon realizes a substantial net financial benefit from the subject leases. On this level, therefore, phase-out of these leases would result in an adverse impact to the Town, particularly in light of the escalating lease fees that would be assessed as the year 2050 approaches.

Public costs that are incurred for storm damage mitigation and remediation due to the presence of the subject communities on the barrier and bay islands is much more difficult to assess (see Section 7.5). Importantly, the beach nourishment and dune restoration projects that are primarily responsible for the erosion and storm protection of the West Gilgo Beach and Gilgo Beach are undertaken for purposes other than the protection of the residences in these two communities. Thus, the costs associated with the beach nourishment and dune restoration projects at Gilgo and West Gilgo Beaches are not attributable to the presence of houses in that area. In contrast, the Sore Thumb was installed for the more or less exclusive purpose of mitigating erosion along the residential shoreline at Oak Beach. Likewise, the maintenance of this structure would be undertaken primarily in consideration of erosion protection for the Oak Beach communities. Thus any public costs that are incurred to reconstruct the Sore Thumb would be directly attributable to the presence of houses to the east. These potential costs would be obviated if the Oak Beach communities were eliminated.

G. ***Homeowner Equity***

As discussed in detail in Section 8, the Town's financial obligation to implement the lease phase-out alternative would be highly dependent on whether the subject leases were allowed to expire at the end of their term in 2050 or were terminated prematurely. The primary advantage of hastening the lease termination date would be the accelerated realization of the benefits that have been identified under the discussion of the other six study elements in this section. However, if this option is chosen, the Town would be obligated to provide remuneration to the displaced residents, and the financial costs associated with this action would likely be substantial. It does not appear that the environmental benefits that would evolve from the premature termination of the current leases would justify the public financial costs that would be incurred.

H. ***Public Access and Recreation***

It has been suggested that phasing-out the residential leases in the Outer Beach communities would create additional opportunities for public recreation. Land that is currently occupied by residential dwellings, and is therefore not available for use by the general public, would become vacant open space. However, the analysis in Section 9 does not indicate that additional recreational facilities and open space are needed in the study area at the present time, nor does it appear likely that such a need will arise in the foreseeable future. Thus, increased availability of public access to the waterfront should not be considered to be a significant factor in the assessment of the benefits that would be derived from the elimination of residential uses on the Outer Beach. Already available spaces (and in some cases underpasses) have never been used in the 60+ years they have been in existence in both Nassau and Suffolk Counties.

6.6.3 *FULL CONVERSION*

The full conversion scenario comprises the transformation of all ±168 existing seasonal dwellings to year-round use. Under this alternative, the 54 houses on Oak Island would remain as seasonal dwellings, in accordance with the terms of the lease agreement with the Town.

The conversion of a seasonal home to year-round use can be accomplished in two basic manners. The existing structure can be retained, in which case necessary modifications would be made to the insulation, utilities, etc. Alternatively, the existing structure can be demolished and a completely new house erected in its place.

Information provided by the Building Department of the Town of Babylon (Finley, Kate; December 22, 1992; telephone communication) indicates that the recent conversions have typically entailed the demolition of existing summer bungalows and replacement with new houses that are used for year-round occupancy. In general, the renovation of existing seasonal houses is no longer considered to be feasible. These houses are often in structurally deteriorated condition, which would require substantial remediation prior to the issuance of a Certificate of Occupancy. Additionally, and perhaps more importantly, the substantial conversion of an existing structure would necessitate adherence to FEMA requirements. Meeting these building standards usually entails great expense, particularly for houses in the V zone. Consequently, retaining the existing structure is generally not a cost-effective option in the conversion of seasonal dwellings to year-round use. Therefore, the following discussion focuses on the construction of completely new houses as the primary means by which conversion is achieved.

A. ***Surface Waters***

It was determined, through the analysis summarized in Section 2, that the subject communities have not significantly affected surface water resources in the vicinity of the study area, even during the summer season when occupancy of these dwellings is more or less 100 percent. Full conversion of existing seasonal homes to year-round use would essentially extend the summer conditions throughout the entire year - except for the potential boat waste discharges, which are confined almost entirely to the summer boating season. Additionally, however, in cases where existing houses are demolished and replaced by completely new structures, the construction of a new subsurface sewage disposal system (SSDS) is also required. Since an SSDS' efficiency of removing contaminants from the septic effluent generally decreases with increasing age, the installation of a new system would improve the water quality of the effluent generated by a converted residence. Thus, although some additional sources of surface water contamination would be operating in the winter time if the full conversion scenario were implemented, this would not be expected to result in significant adverse impacts to the overall water quality of Great South Bay.

B. ***Groundwater***

The expected effect that implementation of the full conversion scenario would have on groundwater quality is similar to the impact that would occur to surface waters (see Section 6.6.3.A). The replacement of some older, failing SSDSs with new devices (in cases where new houses are constructed to replace seasonal dwellings) would result in an improvement in the water quality of the septic effluent from these units, which would slightly improve the quality of the uppermost aquifer during the summer season. In the winter, groundwater quality of the this aquifer would be slightly degraded (compared to the present winter condition), as houses that were previously unoccupied during that season are utilized on a year-round basis. However, conditions under the full-conversion scenario would be no worse than existing summer conditions, and no impacts would result to the deep aquifer (see Section 6.6.2.B).

Full-time occupancy of the subject residences would increase the demand for drinking water in the study area. This would result in a larger annual volume of withdrawal from the aquifer, but would not substantially increase the daily peak usage that presently occurs during the summer season, since the number of occupied homes would remain constant.

C. ***Erosion Control and Flooding***

Implementation of the full conversion scenario would increase the winter population of the subject communities. This situation would increase the possibility that the residents of the subject communities would sustain injuries or death as a result of a severe winter northeaster.

The effect that the full conversion alternative would have on the potential level of property damage in the study area is less apparent. The conversion of a house to year-round use generally entails improvements that increase the property value, which places more property at risk. However, the replacement of an existing summer bungalow with a new dwelling also enhances storm resistance, since the new house must be constructed in accordance with FEMA requirements.

D. ***Interaction with Natural Systems***

Implementation of the full conversion scenario would have a minimal direct impact on vegetation in the study area, since redevelopment will be confined to areas that are currently disturbed. Wildlife will also not be directly impacted, because habitat areas will not be altered.

E. ***Development Potential***

Full conversion of existing seasonal homes to year-round use would not affect the development potential of the vacant lots in the subject communities.

F. ***Community Costs and Benefits***

Full conversion of the existing seasonal homes would be expected to result in an overall financial surplus to the Town. For most services, the cost to the service provider (i.e., the police and fire departments, the lighting district, etc.) would not change substantially from existing conditions, and the increased tax revenues generated by the upgraded houses would be expected to cover any small increase in costs that may occur. The anticipated effect that this development scenario would have on other tax districts (i.e., solid waste and schools) are discussed individually below.

The solid waste district is assessed a fixed fee per house for the 20-year duration of the current contract, which cost is passed directly onto homeowners. Thus, the conversion of the ±168 seasonal homes in the subject communities to year round use will not have an immediate effect on tax levies. However, solid waste costs may increase when a new contract is negotiated, since the contractor (presently BSSI) would be hauling a greater amount of solid waste from the Outer Beach, which is the most distant reach of their service area.

Under existing conditions, it is estimated that the subject communities generate an annual tax surplus for the Babylon School District of $782,000 (see Section 7). At a per student cost of $9,005, this surplus translates into sufficient money to fund the education of approximately 86 additional students. If it is assumed that the ±168 conversions under this development scenario would generate school children at the same rate as applies to the existing year-round homes in the study area (i.e., 42 students/361 year-round homes = 0.12 students per house), there would be an additional 20 students introduced into the school system. Thus, the increase in school-aged children under this scenario would not deplete the district's surplus, even if the extra tax revenues that would be generated by the upgraded houses are not taken into consideration.

G. ***Homeowner Equity***

The full conversion of existing seasonal dwellings to year-round use would somewhat increase the potential financial obligation that the Town faces if the leases were terminated prematurely. As noted above, conversion typically entails the replacement of a small summer bungalow with a large, new house. Since the cost of moving a house is directly related to size, moving cost would be increased following conversion.

H. ***Public Access and Recreation***

Implementation of the full conversion scenario would not have a discernable effect on public access and recreational opportunities, since the total number and location of houses in the subject communities would not be altered.

6.6.4 FULL DEVELOPMENT

The full development scenario comprises a full build-out of the ±82 existing vacant parcels and the full conversion of ±168 existing seasonal homes to year-round use. The development of vacant parcels is contingent upon their meeting the environmental constraints criteria discussed in Section 6.5.2. This alternative does not include conversion of the 54 houses on Oak Island, which are required to remain as seasonal dwellings under the terms of the lease agreement with the Town.

A. *Surface Waters*

Implementation of the full development scenario would have a minimal effect on surface water quality. The slight impacts that are caused under existing conditions would be increased during the winter due to the conversion of seasonal houses to year-round use (see Section 6.6.3.A). Additionally, there could be a minor increase in bacterial input to surface waters derived from septic effluent, especially during storms and extreme tides, due to the construction of houses (and associated SSDSs) on vacant lands in close proximity to wetlands at Gilgo Beach East and West. However, these systems will be required to meet Suffolk County's strict standards and, therefore, will provide better wastewater treatment than the aged systems that are presently in place in these communities. Increased septic wastes from additional development in the other communities with developable vacant lots (i.e., West Gilgo Beach, Oak Beach, and the Oak Beach Association) would not have a measurable effect on surface water quality, since these lots do not adjoin the shoreline or wetland areas.

The expanded resident population that would result from the implementation of this scenario would likely increase the number of water craft in adjacent bay areas during the boating season. This situation may result in a slight increase in the volume of vessel wastewater that is discharged to these surface waters, which would cause a minor elevation in coliform bacteria levels. However, since all of the boat basins along the north shore of Jones Island are presently closed to shellfish harvesting during the boating season as a precautionary measure, a potential slight degradation of water quality resulting from increased boating would not adversely affect the use of the shellfish resources in these waters.

B. *Groundwater*

The volume of sanitary wastewater discharged to the uppermost portion of the aquifer would increase if the full development scenario were implemented. The conversion of existing seasonal dwellings to full-time use would improve the quality of the septic effluent from those units, because the SSDSs attached to these houses would be replaced with new systems. However, the resident population would increase due to the construction of additional homes on vacant parcels, increasing the total wastewater generation rate.

Although the upper lens of fresh groundwater would be adversely affected to some degree if full development occurred in the study area, the water quality of deep portions of the aquifer would not be impacted. As discussed in Section 6.6.2.B, the uppermost layer of groundwater is underlain by saltwater and does not flow downward to the Magothy Aquifer.

As discussed in Section 6.6.2.B, the unregulated installation and abandonment of numerous individual private wells has created a potentially serious problem with local drinking water resources, since these wells can act as conduits for the flow of salty groundwater down to the fresh Magothy Aquifer. Full development of the study area would likely result in an increase in the number of private wells installed by community residents, which would enlarge the magnitude of this problem unless appropriate mitigation measures are implemented in a timely manner.

Full development of the study area would increase the demand for drinking water in the study area. This would result in a larger annual volume of withdrawal from the aquifer. The peak daily usage would also substantially increase, since a greater number of homes would be occupied during the peak (summer) season.

C. *Erosion Control and Flooding*

Implementation of the full development scenario would increase the overall population of the subject communities. This situation would increase the possibility that the residents of these areas would sustain injuries or death as a result of either a hurricane or a severe winter northeaster. In addition, the total amount of property at risk in the subject communities would be expanded. However, in accordance with FEMA requirements, the new dwellings (i.e., both the conversions and the houses that are erected on currently vacant lots) would be constructed in a manner that provides enhanced storm resistance compared to most of the existing homes.

D. ***Interaction with Natural Systems***

Implementation of the full development scenario would directly impact habitat areas of important wildlife species. In particular, the development of the vacant land to the east and west of the existing houses at Gilgo Beach would reduce the extent to which the adjoining marsh areas are utilized by species such as wading shorebirds (i.e., egrets, herons, ibises, etc.). Certain mammals (e.g., raccoons, weasels, and moles) which inhabit areas adjacent to the marshes would also be affected by the development of this land. Additionally, the construction of residences in the vacant area at Gilgo Beach West would directly impinge upon a nesting area for the northern harrier.

The infilling of individual vacant lots within community areas that are already mostly developed would have a minimal impact on ecological resources. These lots are presently devoid of significant wildlife (with the exception of songbirds) because of their isolation from areas of similar vegetation.

Some indirect impacts to wildlife may also result from the full development of existing vacant lots in the subject communities. The resulting increase in the human population would lead to an increase in the amount of garbage generated, which may attract additional raccoons, opossums, gulls, and Norway rats. These species also are predators of a number of the wildlife species that inhabit the surrounding natural areas, and are a particular problem with respect to predation on the eggs of protected plovers and terns. Additionally, the expanded human population may increase the presence of feral dogs and cats in the vicinity of the subject communities, which would also increase the vulnerability of certain wildlife species in nearby areas.

E. ***Development Potential***

By definition, this scenario would entail the construction of dwellings on all existing developable lots in the subject communities. Therefore, development potential in the study area would be zero after implementation of this alternative.

F. ***Community Costs and Benefits***

Implementation of this development scenario would be expected to result in an overall financial surplus to the Town. As with the full conversion scenario, the cost to most service providers (i.e., the police and fire departments, the lighting district, etc.) would not change substantially from existing conditions, and the increased tax revenues generated by the upgraded houses would be expected to cover any small increase in costs that may occur. Town-wide solid waste district taxes would also not be affected, although this assessment may increase when a new contract is negotiated (see Section 6.6.3.F).

As discussed in Section 6.6.3.F, the estimated surplus to the Babylon School District generated by the subject communities is sufficient to cover the education costs for approximately 86 additional students. If it is assumed that the ±168 conversions and ±82 new houses under this development scenario would generate school children at the current level of 0.12 students per house, there would be an addition of 30 students to the school district. Thus, the increase in school-aged children would not deplete the district's surplus, even if the extra tax revenues that would be generated by the upgraded and newly constructed houses are not taken into consideration.

G. *Homeowner Equity*

Implementation of this development scenario would increase the potential financial obligation that the Town faces if the leases are terminated prematurely. The addition of houses on currently vacant lots would increase the number of homeowners who would have to be reimbursed if the Town rescinds the leases prior to 2050. Additionally, as discussed in Section 6.6.3.G, the unit moving cost would be increased for those seasonal houses that are converted to year-round use.

H. *Public Access and Recreation*

Although the full-development scenario involves the construction of houses on lands that are currently vacant, this action would not decrease the degree of public access to the waterfront in the study area. The vacant lands that would serve as new homesites under this alternative (i.e., the undeveloped areas at West Gilgo Beach and Gilgo Beach, and individual lots scattered throughout Oak Beach and the Oak Beach Association) presently do not serve as public access points.

6.6.5 POST-STORM RECONSTRUCTION

The post-storm reconstruction scenario comprises the redevelopment of the subject communities following a devastating coastal storm, which destroys or severely damages a large number of houses in the study area. It is assumed that the maximum number of houses following post-storm reconstruction would equal the number of houses (415) that are presently in place.

The impacts that would result from this scenario of redevelopment are, in many ways, more difficult to assess than any of the previously discussed alternatives. Whereas the number and location of the houses were fixed in the four other scenarios, it is not certain that the study area would be fully redeveloped following a destructive storm, and the probable locations of replacement houses are not clearly defined.

It is possible that redevelopment of the study area under this scenario would be significantly less intense than the existing condition. In cases where dwellings are totally destroyed by a storm, the homeowners may not have the desire to rebuild at the same location, particularly since there exists no ownership bond to the land. If financial resources are strained, which is a very real possibility since it is apparent that a large percentage of houses in the study area are not covered by flood insurance, storm victims may be compelled to simply walk away from their loss (which is allowed under the terms of the lease agreements). Furthermore, once the "big one" hits, the aura of immunity from storm damage that has surrounded the subject communities will have been lifted, and the desirability of residing in the study area would probably be markedly diminished.

Even if substantial reconstruction does occur in the study area following a ravaging storm, there is likely to be significant reconfiguration of the housing pattern in some communities due to a variety of regulatory restrictions, as well as possible voluntary relocations to portions of the study area that are less vulnerable to storm impacts. Some of the more important regulatory provisions that may affect the post-storm redevelopment of the study area are summarized below.

- NYS and Suffolk County regulations require that leaching pools for septic systems be set back a distance of 100 feet from both wetlands and surface waters. Existing lots at several locations in the study area (i.e., Gilgo Beach West, Oak Island, and Captree Island) do not conform with these provisions. Reconstruction on each of the affected lots would require the issuance of a variance from the State and/or the County. Unless the needed variances are granted, replacement houses cannot be erected on these lots.

Outer Beach residents who desire to reconstruct their storm-damaged homes, but who are prohibited from undertaking this action due to regulatory restrictions, can pursue the use of one of the developable vacant parcels that exists in the study area. However, the number of lots is limited (82 maximum), and their locations may not be considered to be as desirable as the waterfront sites that could potentially be banned from redevelopment by regulatory restrictions.

A. ***Surface Waters***

As discussed in Section 2, contaminants carried by stormwater runoff are the primary cause of surface water quality deterioration in the vicinity of the study area. Under normal circumstances, the natural vegetative buffer surrounding the developed areas in the subject communities serves to adequately filter runoff prior to its arrival at nearby surface waters. The devegetation of a construction site accelerates the rate of runoff and increases the volume of stormwater that is discharged to surface waters. A single residential lot under development, especially in an area of relatively level terrain such as exists in the study area, generally will not significantly affect surface water quality. However, in the aftermath of large-scale storm destruction, reconstruction activities may be underway at numerous adjacent parcels. Stormwater runoff flowing from these disturbed sites can have localized deleterious impacts on receiving waters unless suitable erosion and sediment control measures are implemented.

The reconstruction of dwellings following a major storm would tend, overall, to have a long-term positive impact on surface water quality, compared to pre-storm conditions, in terms of potential impacts from septic effluent generated in the study area. Post-storm reconstruction would likely result in increased setbacks between SSDSs and surface waters to meet Suffolk County requirements, or the abandonment of certain waterfront parcels altogether. Furthermore, the SSDSs installed for the replacement houses would be constructed in accordance with the latest standards, providing an improved level of treatment to the effluent compared to the pre-storm SSDSs.

B. *Groundwater*

Due to the upgrading of SSDSs that would be undertaken in association with the reconstruction of damaged homes, the overall water quality of the shallow aquifer would be expected to become somewhat improved compared to the pre-storm condition. Pumpage from the deep aquifer would not be adversely affected by post-disaster reconstruction, since the total number of homes would not be increased. Any decrease in the population of the subject communities that is caused by a disaster would result in a commensurate improvement in both the quality of the upper aquifer and the quantity of deep groundwater withdrawn for residential use in the study area.

C. *Erosion Control and Flooding*

Assessment of the impact that a disastrous coastal storm would have on the ability of the subject communities to withstand future storm damage is not straightforward. Typically, such a storm inflicts severe erosion on the shoreline, which decreases the natural protection provided against future storms. However, to the extent that a major storm causes residents to rebuild vulnerable homes in accordance with FEMA requirements, or to abandon high hazard sites entirely, the storm resistance of individual homes would be significantly improved.

D. *Interaction with Natural Systems*

As with the consideration of potential impacts that would result to erosion control and flooding, the assessment of the effect on natural systems due to redevelopment following a devastating coastal storm is not straightforward. Certain aspects of post-storm redevelopment would benefit wildlife species; for example, removing houses from shorefront areas would expand the habitat available to plovers and terns. Other aspects of the redevelopment would adversely affect wildlife, especially if the vacant land at Gilgo Beach is used as a relocation site for houses.

E. *Development Potential*

Since some building lots that are presently vacant would probably be used for the reconstruction of homes that are destroyed by a major storm, the number of lots available for future use would be decreased.

F. *Community Costs and Benefits*

As noted in Section 6.6.2.F, the public costs that would be incurred for the remediation of damage in the study area caused by a destructive storm are much more difficult to assess than the day-to-day costs of providing services to the subject communities. However, it is possible that these costs would be substantial, in terms of both direct expenditures for cleanup and restoration, and indirect subsidies for reconstruction.

The financial cost of remediating damage in the subject communities caused by a major storm cannot be assessed accurately on a generic basis, since too many variables come into play. However, it is clear that these costs would at least partially offset the financial benefit that the Outer Beach communities render to the Town during normal conditions.

The reconstruction of storm-damaged houses could involve the abandonment of lots at vulnerable locations, in favor of sites that are less susceptible to future storm damage. This action would decrease the potential for public funds to be expended in response to future storm events, while maintaining a steady income of tax revenues and lease fees. Alternatively, the outright abandonment of lots on which substantial storm-related structural damage occurred would eliminate the potential for those houses to submit the Town to future storm-related public expense; however, the tax and lease revenues derived from these houses would also cease.

G. ***Homeowner Equity***

The issue of homeowner equity is quite different with respect to post-storm conditions than under any of the other scenarios of development analyzed in Section 6.6. The terms of the leases and subleases grants the tenants the right to terminate the lease or sublease at any time; however, the tenant would be liable for rent through the end of the year. If this termination option is exercised by a leaseholder, the Town would not be liable for any costs associated with the relocation of that leaseholder.

The Town has the option to terminate the leases at any time. As noted previously, the termination of leases for lots on which functional houses are sited would subject the Town to certain expenses (i.e., the cost to relocate the house and reimbursement to the tenant for the loss of the usage of the property). In addition, the Town must anticipate the possibility of legal action by the residents under the claim of breach of contract if the leases are prematurely terminated on the Town's initiative. However, as discussed below, certain of these negative aspects would be minimized if the Town determines that it would be beneficial to terminate leases for lots on which storm damage has destroyed the houses.

In the case of a lease termination for a property on which the house has been destroyed during a storm, the Town would still be liable to provide reimbursement for the tenant's loss of the use of the property. However, the relocation cost would not be applicable, since there would be no structure to be moved (although the Town would be responsible for the removal of debris from the property). Further, the chances of a successful legal challenge by the tenant would be diminished under these circumstances, since the Town would have a strengthened justification for early lease termination, based on the position that building sites which have suffered severe storm damage are clearly vulnerable to future damage.

H. ***Public Access and Recreation***

Reconstruction following a disastrous storm would not decrease public access and recreational opportunities in the vicinity of the study area. The total number of houses in the subject communities would not be increased under this scenario and, as discussed above, would likely be decreased.

Post-storm rebuilding may entail the abandonment of certain lots on which houses are presently located, particularly parcels situated in high hazard areas along the shore. These leases, if continued, would be transferred to parcels that are located further inland, resulting in a shift of development away from the shoreline. This action would result in an increase in open space along the shoreline and would, therefore, enhance public recreational opportunities at the waterfront.

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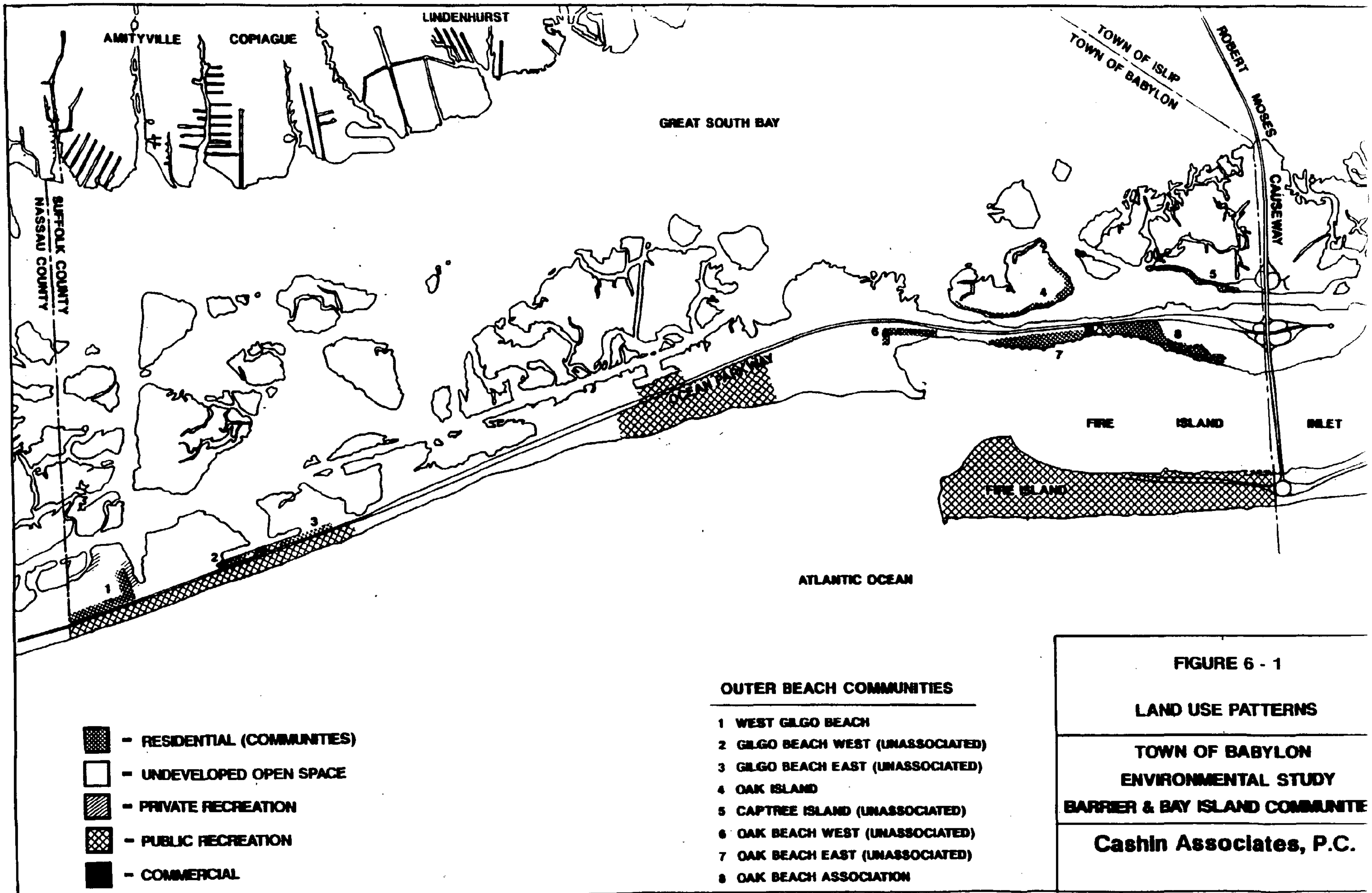

FIGURE 6 - 1

LAND USE PATTERNS

TABLE 6-1

STUDY AREA ACREAGE

	TOTAL (In acres)
Barrier Island:	
Residential Communities -	
West Gilgo Beach	38
Gilgo Beach	15
Oak Beach *	44
Oak Beach Association	52
	149
Recreational Uses -	
Gilgo Beach and Boat Basin	65
Cedar and Overlook Beaches	173
Cedar Beach Marina	39
Private Recreation **	8
Gilgo State Park	1223
	1508
Vacant/undeveloped Land	395
Ocean Parkway and Right-of-way	182
	2234
Bay Islands:	
Residential Communities -	
Captree Island	15
Oak Island	19
	34
Undeveloped/vacant Islands	2268
	2302
TOTAL ACREAGE	4536

* Includes the property comprising the Oak Beach Inn.
** Includes Seaford Harbor Yacht Club, Unqua Corinthian Yacht Club and the West Gilgo Beach Association Dock.

Source: Suffolk County Tax Maps, Real Property Tax Service Agency, Riverhead, NY, 1992. G. Gorman, NYSOPRHP, December 21, 1992.

TABLE 6-2

IDENTIFICATION OF PROPERTIES WITHIN THE STUDY AREA

		SUFFOLK COUNTY TAX MAPS			TOWN OF BABYLON LOT MAPS		
COMMUNITY	OCCUPIED RESIDENTIAL LOTS	VACANT LOTS	OTHER LOTS *	TOTAL LOTS	VACANT LOTS	OTHER LOTS *	TOTAL LOTS
WEST GILGO BEACH	80	5	3	88	115	5	200
GILGO BEACH	57	2	3	62	17	0	74
OAK ISLAND	54	9	1	64	45	0	99
OAK BEACH WEST	24	9	0	33	111	0	135
OAK BEACH EAST	96	7	5	108	9	6	111
OAK BEACH ASSOCIATION	72	36	0	108	42	0	114
CAPTREE ISLAND	32	0	0	32	1	0	33
TOTAL	415	68	12	495	340	11	766

* Other lots are parcels occupied by community or public recreational facilities, and/or commercial structures.

Source: 1992 Suffolk County Tax Maps, Town of Babylon lot maps (various dates), and 1992 aerial photography.

TABLE 6-3

B-RESIDENCE ZONING DISTRICT REQUIREMENTS

Maximum Permitted:	
Lot Coverage	20 percent
Building Height	35 ft. or 2½ stories
Minimum Required:	
Lot Area	10,000 sq. ft
Lot Width	80 ft.
Front Yard	30 ft.
Rear Yard	40 ft.
Side yards (2 required):	
both	30 ft.
each	12 ft.

Source: Town of Babylon Zoning Ordinance, Chapter 213, Effective as amended September 25, 1990.

TABLE 6-4

Average Size of Existing Lots in the Study Area Communities

COMMUNITY	AVERAGE LOT SIZE (s.f.)
West Gilgo Beach	8,850
Gilgo Beach - West (all lots)	7,500
- East (all lots)	8,350
Oak Island	20,000 - 40,000 (1)
Oak Beach - West	7,800
- East	8,500 (2)
Oak Beach Association	10,000 - 20,000 (3)
Captree Island	20,000

(1) A few small lots range between 8,000 and 10,500 s.f.

(2) A few small lots measure under 6,000 s.f.; largest lot is 14,700 s.f.

(3) Smallest lot is 7,500 s.f.; largest lot is 39,000 s.f.

SECTION 7

SECTION 7
COMMUNITY COSTS AND BENEFITS

SECTION 7
COMMUNITY COSTS AND BENEFITS

7.0 INTRODUCTION

Like other areas in the Town of Babylon, the study area generates property tax and other revenues and, in return, is provided various public services from a number of agencies. The purpose of this section of the report is to identify what services are received by the study area communities and to determine the cost of supplying these services. Additionally, the total amount of property taxes and other revenues generated by the communities has been calculated to determine what net economic impacts, if any, have resulted from the development of the barrier and bay islands. By estimating what it costs to provide essential services, and what the community generates in local revenues, it can be determined if the study area is paying for the services they receive or if it is costing the Town and other local districts additional monies to maintain this Outer Beach area.

The cost-benefit analysis presented below focuses primarily on the day-to-day activities of local governmental entities, including the Town, County, and local service districts. The impact of the subject communities on the day-to-day operating costs of the State and Federal governments is not examined here because of the inherent difficulty in assessing these costs on a community-specific basis. However, there does not appear to be any reason to believe that the Outer Beach communities (which generate revenues for the State and Federal governments primarily through income and sales taxes) are having a significant adverse cost-benefit effect on day-to-day State and Federal operations.

It should be noted that the quantitative cost-benefit analysis that follows does not account for costs that may be incurred due to damages caused by a catastrophic storm. Further discussion of this topic is presented in Section 7.3.

7.1 PUBLIC SERVICES IN THE STUDY AREA

7.1.1 IDENTIFICATION OF COMMUNITY SERVICES UTILIZED IN THE STUDY AREA

Public services are provided to residents in the study area by a number of public agencies. These services are financed through property taxes remitted to the County and the Town, which act as the tax collectors for the various agencies. The community services received by the subject communities include fire and police protection, roadway maintenance, street lighting, solid waste collection and disposal, public school and library services, and the general municipal services provided by the Town and County. However, as is discussed in further detail in Section 7.1.2, not all of the Outer Beach communities receive all of the services listed.

7.1.2 MUNICIPAL COSTS FOR SERVICES RENDERED TO THE STUDY AREA

A. Roadway Maintenance

The Town of Babylon Highway Department maintains Town roads for the mainland portion of the Town. The Town-owned roadways on the Outer Beach, however, are maintained by the Department of Buildings and Grounds. Some of the subject communities maintain their own roads.

According to the Department of Buildings and Grounds (D. Golden, TOB, September 29, 1993), the 1992 cost to the Town for roadway maintenance for the community portions of the Outer Beach was $13,146, which can be broken down as follows:

Roadway sweeping	$2,220
Hot Patch Pothole Repair	3,311
Snow Removal	5,971
Oak Beach Avenue Drainage(*)	1,644
Total	$13,146

Note (*): Due to occasional flooding on Oak Beach Avenue, which is a roadway with poor drainage, the Town must pump flood waters during extreme storms.

B. Street Lighting

The Town's Street Lighting Division is responsible for Lighting District No. 55 within the study area, which consists of Gilgo Beach, Oak Beach, and the Oak Beach Association. According to the Town of Babylon Department of Electrical Services, there are no street lights on Oak Island, as the island has no electrical service. The Captree Island community also has no street lighting system (Proulx, TOB, November 30, 1992). Based on a field survey conducted by CA, the total number of street lighting fixtures in the Oak Beach and Gilgo Beach communities is 67. This tally includes fixtures present in the parking lots of the Oak Beach Inn and Gilgo Beach Marina, which serve as points of entry for the respective communities.

The West Gilgo Beach Association has 22 light fixtures that were installed by the Long Island Lighting Company, not the Town of Babylon. Presently the West Gilgo community pays LILCO directly for electrical costs and is responsible for maintenance of the fixtures. Preliminary discussions were entered into with the Town of Babylon regarding the possibility of transferring maintenance responsibility for this lighting system to the Town's Street Lighting Division. However, these negotiations have resulted in the West Gilgo Beach homeowners' association deciding to retain the current arrangement for the time being.

According to information provided by the Town, the total street lighting budget for 1991 was $1,458,798. The Town-wide total street light inventory was placed at 12,947 fixtures. Thus, the cost of maintaining fixtures can be estimated at $112.68 per fixture on a Town-wide basis. If it is assumed that this average maintenance cost applies to the fixtures in the Outer Beach communities, the annual cost for the 67 fixtures that are maintained by the Town would total $7,662.

C. Police Protection

The residential communities within the study area are served by the Marine Bureau of the Suffolk County Police Department (SCPD) at Timber Point. The area is patrolled via automobile, with the exception of Oak Island, which is patrolled with a police boat (Widmeyer, SCPD, December 4, 1992). Ocean Parkway and Robert Moses Causeway are under New York State jurisdiction and are patrolled by New York State Police. The Town of Babylon Enforcement and Security patrol the study area and respond to situations at all Town beaches and marinas on the barrier island as well as on the mainland. According to the Town of Babylon Department of Enforcement and Security, there is no separate budget for services provided in the study area as opposed to the mainland (Thompson, TOB, November 18, 1992).

Information provided by the SCPD indicates that their motor vehicle patrol of the barrier island in the Town of Babylon operates 24 hours per day, 365 days per year, at a cost of approximately $640,000 annually (Erickson, January 13, 1993). However, the patrol territory is largely comprised of areas outside the six subject communities; and includes the Oak Beach Inn, which is involved in a large proportion of the police responses. Therefore, the actual cost of patrolling the Outer Beach communities alone would be substantially less than the $640,000 necessary to provide police service to the entire Babylon barrier beach. It is assumed for the purposes of this analysis that $320,000 (or 50 percent) represents the share of the total cost that is attributable to the communities.

D. Fire Protection and Emergency Medical Services

Fire protection and emergency medical services (ambulance and EMT response) in the study area are provided by the Babylon Village Fire Department (BVFD), which has divided the Outer Beach into two districts. The eastern district (No. 54) includes Captree, Oak Beach East and West, and the Oak Beach Association. The western district (No. 53) includes Gilgo Beach East and West, and West Gilgo Beach Association.

Although Oak Island residences are not within a fire district, the Babylon Village Fire Department would respond if a fire or medical emergency occurred in that community (Mier, BVFD, December 1, 1992). Since the BVFD does not maintain a fire boat, they generally rely on the Coast Guard for such equipment. The Town's harbormaster has access to the Bay Constable boats which would also be used by the BVFD to respond to a fire on Oak Island. Because of these circumstances, a response in this community would require a greater effort and expense; however, an incident in this community has not occurred in recent years.

Oak Island has a small fire house, which is equipped with a flat bottomed boat with a pumper of unknown condition. Some of the other communities (specifically the associated areas of West Gilgo Beach and Oak Beach) also have their own fire fighting equipment, and require residents to be trained in its use (Kluesener, TOB, November 19, 1992). Thus, the Outer Beach communities are somewhat less reliant on the fire fighting equipment of the BVFD than other portions of the fire district, which is a practical necessity due to the relatively long response time to the barrier island from the fire station on the mainland. However, the houses in the subject communities are assessed taxes for the fire district at the same rate as mainland communities.

The entire budget of the Village of Babylon Fire Department for 1992 was approximately $500,000. District Fire Chief, Robert Mier, estimated that the BVFD responds to approximately 1,100 incidents per year, of which approximately ten percent occur on the barrier beach. Thus, the fire district funds that are directed at responding to incidents in the Outer Beach can be estimated at approximately $50,000. As with police services, a large portion of this effort relates to incidents occurring outside the subject communities, including the Oak Beach Inn and along Ocean Parkway. Very few medical responses to the communities have occurred and no fire responses were required there in recent memory (Mier, BVFD, December 1, 1992).

Automobile accidents on the Ocean Parkway account for most of the situations that the fire department responds to on the barrier beach. It was reported that there are between 10 to 15 rollovers per year on the parkway in addition to multiple car collisions. The average response time to this area is between 7 and 12 minutes. A unique problem to this area is that there are no fire hydrants in most communities and water must be pumped from the bay in order to fight fires. Although the salt water can be detrimental to the equipment, with proper maintenance this has not been a problem. The department's equipment consists of 6 engines, 1 ladder and 1 ambulance. No Fire Department equipment is stored at the barrier island.

E. Public School

The study area lies within School District No. 1, which is the Babylon Village School District. There are presently 42 public school students who live in the study area communities, none of whom live on Oak Island (R. Fedelem, LIRPB, September 24, 1992). There are 23 students enrolled at the elementary school, while 19 students are enrolled at the high school. According to school district officials, the average cost per pupil in this district is $9,005. Based on the current number of students in the study area, this translates into a cost to the school district of $378,210.

Transportation costs for students in the study area are handled by the district in the same manner as students on the mainland. The district has a bid contract with a private bus company. The cost per bus is fixed, independent of its route. The New York State Department of Education reimburses the school district 90 percent of transportation costs for all students living more than 1.5 miles away from the school. Therefore, the cost of transporting students from the study area is no greater to the school district than it is on the mainland for students living over a mile and one-half from the school. The district pays a total of $53,000 annually for transportation, $48,000 of which is reimbursed by the State for a net cost of $5,000 in school district busing costs, which is included in the $9,005 average per pupil cost.

F. *Library Services*

Revenue is collected by the Town of Babylon through property taxes in order to finance the library districts within the Town. A total of $72,091 (Bartow, TOB, November 26, 1992) was collected from the study area for tax year 1991. All monies collected from Babylon residents are applied to Library services throughout the Town. There are no records kept as to library usage by community. However, it is likely that the Outer Beach communities place a proportionately lower demand on library services compared to other residents of the library district. This conclusion is based on a number of factors, including: the relatively long travel distance between the barrier island and the library, which would tend to discourage frequent trips to the library; the large portion of the Outer Beach residences that are used only during the summer season, which causes a decrease in the winter population of these communities; the relatively low number of school children, who represent one of the primary user groups of the public library system; and the existence of community libraries in some of the Outer Beach communities.

G. *Municipal Solid Waste*

The Town is presently under contract with Babylon Source Separation Incorporated (BSSI), a private carting company that collects and disposes of all Town municipal solid waste at the Resource Recovery Facility in West Babylon. BSSI handles solid waste for all unincorporated portions of the Town and the Village of Babylon, including the Outer Beach communities.

BSSI's contract provides for collection from all households at a cost of $330 per year per household, regardless of location within the Town. Thus, the cost of collection for each house on the Outer Beach, if calculated separately, would exceed the $330 billed under the current contract due to the longer transport distances; while collection in the area adjacent to the Resource Recovery facility, if calculated separately, would be less than $330. In this sense, solid waste collection at locations furthest from the Resource Recovery Facility, particularly the barrier beach, is partially subsidized by households close to the site. However, this effect is offset to some degree by the fact that a large percentage of the homes on the Outer Beach are seasonal, and the carter incurs no collection expense for these houses during off-season when they are unoccupied. No information is available with regard to the relative effect that increased carting distance and decreased collection effort during the winter have on BSSI's actual costs for solid waste collection in the study area.

7.2 ECONOMIC BENEFITS OF THE OUTER BEACH COMMUNITIES

The economic benefits provided to local governmental agencies by the Outer Beach communities are two-fold, comprising monies paid directly to these agencies in the form of taxes and fees, and monies generated as a secondary result of economic activity (e.g., income and sales taxes). The primary source of local public revenues is property taxes, which are paid to various agencies (as described in Section 7.1) that provide services to the residents of the subject communities. Additional revenues are generated for the Town by annual rental fees and lease transfer fees.

As shown in Table 7-1, property tax revenues generated by the residential communities in the study area totalled $1,921,090 for 1991 (Bartow, TOB, November 24, 1992). Rental fees for that same year equalled $198,061 (Kluesener, TOB, October 13, 1992), but are due to escalate over the coming years in accordance with the terms of the leases (see Appendix E).

Lease transfer fees are based on home sale prices and, therefore, will vary from year to year according to annual sales activity. According to data provided by the Babylon Town Clerk's Office, the total revenue generated from lease transfer fees in 1991 was $65,195. However, this amount does not reflect a full year of home sales activity, since the collection of lease transfer fees commenced in October of that year. Furthermore, this $65,195 in lease transfer revenues is not representative of a typical three months of real estate activity, since a number of home sales that may otherwise have transpired earlier were delayed until the lease transfer issue was resolved by the Town. Lease transfer income for 1992 (the first full year of collection) was $81,188, an increase of $15,993 from the 1991 revenues.

Combining the three primary direct revenue sources to local government entities (i.e., property taxes, lease fees, and lease transfer fees), the total payment from the study area communities for 1991 was $2,184,346. This revenue is money that would not be collected from the study area if this land were undeveloped. The $348,253 in Town revenues collected from the subject communities (see Table 7-2) represents approximately 2.5 percent of the Town total of $13,707,555 for the 1991 combined general levy and levy for the portion of the Town outside the incorporated villages.

A secondary economic benefit to the Town are those extra taxes paid to the Town by the business community that supplies goods and services to the study area residents. Additionally, the sales tax paid on those goods and services is included in the County and State revenues, which support those levels of government and partly subsidize local community services. Annual sales taxes paid per household is a function of that household's disposable income. The average household income for the Town of Babylon is $45,832 and the average household income for the year-round residents of the study area is $53,424 (Town of Babylon, 1993).

Although homeowners on the mainland pay mortgage costs for both their homes and their land, this does not constitute a greater cost as compared to the study area. Study area residents pay a lower mortgage cost because they are only financing the purchase of their home and not the land. However, the current lease fee is set at a rate that generally makes up the difference in these mortgage costs. In addition, both the study area and mainland residents are paying comparable property taxes annually. Therefore, it is estimated that the cost of living in the study area is essentially the same as the mainland. Since the average household income in the study area is higher than the average household income on the mainland, it can be stated that the study area residents have a greater disposable income, thereby generating a greater amount of secondary tax revenues.

Tax revenue generated from the study area totals approximately 0.62 percent of total Town-wide tax revenue. Depending on whether the 1990 census or the information gathered during the homeowner survey of this study are used, the number of year-round households on the Outer Beach is estimated at 195 to 231, which comprise approximately 0.30 to 0.36 percent of the Town of Babylon's 64,506 households. The population ratio of the study area to the entire Town is 0.23 percent. From these data, it can be said that the study area residents pay a disproportionately high percentage of the Town's property taxes, especially in light of the fact that 46 to 53 percent of the Outer Beach houses are occupied only on a seasonal basis.

7.3 FINANCIAL COST-BENEFIT ANALYSIS

An analysis of the public costs and benefits associated with the existence of the Outer Beach communities is relatively straightforward, in concept. The existence of these communities requires the expenditure of public funds for various services, as discussed in Section 7.1. In return, the residents of these communities contribute to public coffers through tax levies and other fees, which are described in Section 7.2. If the cost of services rendered is less than the revenues generated, there is a net surplus. If the cost of services exceeds the revenues, a net deficit results.

7.3.1 METHODOLOGY

The direct financial benefits of the subject communities can be expressed simply in terms of the revenues generated through tax levies and other assessments (including rental fees and lease transfer fees). The indirect financial benefits (such as those generated through income and sales taxes) are more difficult to determine accurately, but would provide additional revenues to various governmental levels and to local businesses. These indirect revenues were not included in the quantitative cost-benefit analysis presented in this report.

The quantitative cost benefit analysis that follows considers the annual revenues generated by the Outer Beach communities versus the costs of normal services provided by nine taxing districts (i.e., the Town and County general funds, County Police, highway, school, fire, library, lighting, and refuse). The findings discussed in Section 7.3.2 are valid in terms of the day-to-day operating expenses of the various districts. However, it is important to recognize that additional public costs would likely be incurred in the event of the devastating storm striking the Outer Beach. These costs could be substantial, and could affect the balance between the public expenditures and financial benefits associated with the subject communities. In particular, the houses in the communities at West Gilgo, Gilgo, and Oak Beaches and along the eastern shore of Oak Island are situated entirely within the V flood zone, indicating that these areas have been determined by scientific analyses to be susceptible to significant storm wave damage during the 100-year storm event. Although, in general, the bay islands are not similarly subject to high intensity storm waves, these back-bay communities can still sustain significant damage due to elevated water levels and lower energy waves. In fact, the greatest structural damage to a single home caused by the December 1992 northeast storm occurred in the A zone portion of Oak Island.

The total public cost arising from a relief effort to the Outer Beach communities following a catastrophic storm would depend on a multitude of factors, including: the condition of natural protective features (i.e., beaches, dunes, and offshore shoals), which is determined by the effect of previous storms and seasonally variable geologic processes; meteorological aspects of the storm (e.g., wind speed, storm size, speed, and track, rainfall amount, astronomical tidal stage, etc.); and the extent to which storm damage costs are covered by insurance. Public costs (at Federal, State, County, and local levels) would be incurred in a number of ways, including the following:

- use of manpower to effect evacuation of the study area and to patrol the area during the period while the homes are evacuated, to prevent potential looting
- increased demands on evacuation centers, compared to the demand that would occur if there were no residential development on the Outer Beach
- debris cleanup, particularly on local roadways (publicly-financed shoreline cleanup would be directed mostly at restoring public recreational resources)
- public financial relief to homeowners not covered by adequate insurance (e.g., through Small Business Administration loans)
- potential medical response costs for residents who may be injured in the storm

It is important to note that expenses associated with efforts to shore up or repair Ocean Parkway along the Gilgo/West Gilgo oceanfront following a storm would not be attributable to the presence of the subject communities, since the decision to undertake such action would be based on regional transportation and recreation considerations (see Section 4.5.3). In contrast, public costs incurred due to the reconstruction of dunes, beach nourishment, and similar post-storm restoration activities along the Oak Beach shorefront would likely be related primarily to the presence of residential development in this area, although some consideration may be given to the protection of public lands and facilities.

It is also important to recognize that wind and rain can cause a significant portion of the property damage resulting from a coastal storm, and that these forces act at inland locations as well as at flood-prone locations (although the magnitude of storm winds is generally higher at coastal locations due to sparser vegetation and lower building densities, resulting in less wind attenuation than at inland locations). As noted in Section 4.2.2, the storm damage on Long Island caused by Hurricane Gloria (in 1985) and in southern Florida and Louisiana caused by Hurricane Andrew (in 1992) resulted primarily from wind forces at inland locations. Therefore, in examining the public costs associated with storm damage to the Outer Beach communities, it is essential to distinguish between those damage costs related to wind forces (to which these houses would be exposed even if they were at an upland location) and those damage costs related to the flooding and erosion hazards of the Outer Beach.

It is also important to recognize that public ownership of the land on which the subject communities are located allows the Town the option of terminating the leases and prohibiting reconstruction of homes that are heavily damaged or demolished by a catastrophic storm. Although the full legal ramifications of such action would have to be explored further, the implementation of this option could substantially moderate the public cost of post-storm recovery and would reduce the susceptibility of the study area to future storm damage. Potential future storm damages would also be reduced through the implementation (via the Town's Coastal Erosion Hazard Area law) of the regulatory prohibition on the restoration of any house in the CEHA that has sustained substantial storm damage.

7.3.2 ASSUMPTIONS

In order to arrive at the bottom line value for the financial cost or benefit of the Outer Beach communities to the Town and the various other service districts, a number of assumptions had to be made. In general, these assumptions pertain to service districts that do not have data records in a form that allows the service costs incurred specifically for the subject communities to be extracted from the overall district-wide costs. For example, the Town of Babylon does not maintain records which can be used to determine what portion of its overall $13 million general levy (including the separate levy for unincorporated areas) is directed to Outer Beach residents. Similarly, there is no way to assess the portion of the Suffolk County tax revenues generated in the Outer Beach that are returned to those communities in the form of services. In addition, the public library system's records of the usage of resources are not segregated by community. In these three cases (i.e., the Town general fund, Suffolk County, and the library system), it is assumed for the purposes of this cost-benefit analysis that the tax revenues generated in the study area by each respective entity are equivalent to the costs of services rendered to those residents.

The assumption discussed above is believed to be conservative with respect to the library district; as described in Section 7.1.2.F, it is likely that Outer Beach residents actually utilize library resources to a lesser degree than the remainder of the district populace, in which case the cost to the library district to serve the subject communities would be less than the tax revenues generated by those communities. With regard to Town and County costs and services (other than highway and lighting taxes), since these are general levies, the entire population has more or less equal access to the services that are funded by these revenues. Therefore, it is valid to assume that the distribution of services is balanced among the various communities within the Town.

As noted in Section 7.1.2.C, the Suffolk County Police Department has estimated the cost of patrolling the Outer Beach at $640,000, which includes the Oak Beach Inn and other locations outside of the subject communities. Although it is clear that the portion of this cost that is directly attributable to the communities is less than the $640,000 overall cost, there was insufficient information available to ascertain this cost allocation. Further, it is unknown whether the $204,141 in police tax revenues generated by the 415 Outer Beach residences is adequate to cover the communities' share of the patrol costs. Therefore, it is assumed for the purposes of this cost-benefit analysis that 50 percent of the total expense for the Outer Beach patrol is attributable to the subject communities. Applying this assumption results in a $115,859 annual deficit versus the $204,141 in County Police taxes collected from the subject communities.

The cost of providing the remaining services (i.e., highway, school, fire, lighting, and refuse) to the Outer Beach communities is based on data gathered from the respective districts, as is described in Section 7.1.2.

7.3.3 FINDINGS

As shown in Table 7-1, the total tax revenues collected from the barrier beach communities for 1991 were $1,921,090. This revenue total is increased to $2,184,346 when rental and lease transfer fees to the Town are taken into consideration (see Table 7-2). The total estimated cost of services in 1991 for the nine taxing districts that encompass the subject communities, derived on the basis of the assumptions discussed in Section 7.3.1, is $1,146,698. Thus, the Outer Beach communities generated an estimated overall net $1,037,648 surplus during 1991.

The largest surpluses to individual districts in 1991 were the $782,312 to the school district and the $263,256 to the Town (not including the highway and lighting districts). The extra revenue received each year by the school district would decrease if the number of public school pupils from the Outer Beach increased; however, there are no definitive data available which show that the school-aged population of the subject communities is on the rise. The Town's net revenues from the residential development on the Outer Beach may fluctuate from year to year, depending on the sales activity of these homes (and the lease transfer fees generated as a result). However, the long-term trend should be a relatively steady increase in net revenues to the Town, since the rental fees are scheduled to escalate over the term of the leases. By the year 2046 the annual rent due from each lessee will be $6,400, except Oak Island residences which will each have a $3,200 rental fee. The total lease fee for the 415 houses in the study area will be $2,483,200 in 2046 (compared to $198,061 for 1991).

The Outer Beach communities also generate surpluses to the Fire District (estimated at $55,249 for 1991), the Town Highway Department ($50,465), and the Town Lighting District ($2,225). The County general fund, library district, and refuse district are assumed to incur no net financial cost or benefit as a result of services rendered to the subject communities.

Of the nine districts, only the Police Department shows a net deficit due to the cost of services rendered to the Outer Beach versus the tax revenues generated. These results are based on the assumption that 50 percent of the total expense for the Outer Beach patrol is assigned to the subject communities (with the remaining 50 percent assigned to the patrol of the Oak Beach Inn and other non-community areas). In fact, as discussed in Section 7.3.1, the available data are not sufficient to indicate whether or not police tax revenues generated by the Outer Beach communities is adequate to cover the communities' share of the patrol costs. However, even if it is assumed that the entire $640,000 cost of the Outer Beach Police Patrol is attributable to the communities, there would still be a net overall surplus of $717,648 to all nine districts combined.

It is important to recognize, as was discussed earlier in Section 7.3, that the generation of a surplus of the magnitude indicated in Table 7-2 is based on the evaluation of normal day-to-day public agency costs. The occurrence of a catastrophic storm would likely have a substantial effect on the balance of costs and benefits due to expenditures necessitated by various storm response activities.

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Table 7-1
Property Tax Revenues Generated by the Study Area Communities

	WEST GILGO BEACH	%	GILGO BEACH	%	OAK ISLAND	%	OAK BEACH	%	OAK BEACH ASSOCIATION	%	CAPTREE ISLAND	%	STUDY AREA TOTAL	%	DISTRICT TOTAL
TOWN *	16,007	0.12	11,049	0.08	5,240	0.04	26,445	0.19	20,394	0.15	5,862	0.04	84,997	0.62	13,707,555
TOWN HIGHWAY	11,980	0.15	8,272	0.10	3,931	0.05	19,788	0.25	15,251	0.19	4,389	0.05	63,611	0.79	8,022,164
SUFFOLK COUNTY	20,826	0.11	14,376	0.08	6,841	0.04	34,406	0.19	26,550	0.15	7,631	0.04	110,630	0.61	18,158,974
COUNTY POLICE	38,437	0.12	26,546	0.08	12,636	0.04	63,465	0.20	48,974	0.16	14,083	0.04	204,141	0.65	31,460,011
SCHOOL DISTRICT	212,109	1.69	149,286	1.19	70,734	0.56	354,062	2.83	285,415	2.28	88,916	0.71	1,160,522	9.27	12,520,754
FIRE DISTRICT	30,840	6.17	21,694	4.34	0	0.00	25,685	5.14	20,535	4.11	6,495	1.30	105,249	21.05	500,000
LIBRARY DISTRICT	13,179	1.69	9,272	1.19	4,375	0.56	22,006	2.82	17,732	2.27	5,527	0.71	72,091	9.24	780,296
LIGHTING DISTRICT	44	0.00	1,530	0.10	710	0.05	3,706	0.24	2,960	0.19	937	0.06	9,887	0.64	1,537,144
REFUSE DISTRICT	23,542	0.18	16,986	0.13	0	0.00	37,250	0.28	22,648	0.17	9,536	0.07	109,962	0.82	13,398,126
TOTAL	366,964		259,011		104,467		586,813		460,459		143,376		1,921,090		

NOTES:

* = Includes the general levy and levy for outside Villages.

percentages are based on district totals

Table 7-2
Cost Benefit Analysis of Services Rendered to the Outer Beach Communities

	REVENUES GENERATED	ESTIMATED COST OF SERVICES	NET SURPLUS TO DISTRICT**
TOWN	348,253 *	84,997 (1)	263,256
TOWN HIGHWAY	63,611	13,146 (2)	50,465
SUFFOLK COUNTY	110,630	110,630 (3)	0
COUNTY POLICE	204,141	320,000 (4)	(115,859)
SCHOOL DISTRICT	1,160,522	378,210 (5)	782,312
FIRE DISTRICT	105,249	50,000 (6)	55,249
LIBRARY DISTRICT	72,091	72,091 (7)	0
LIGHTING DISTRICT	9,887	7,662 (8)	2,225
REFUSE DISTRICT	109,962	109,962 (9)	0
TOTAL	2,184,346	1,146,698	1,037,648

NOTES:
* = Includes the general levy and levy for outside Villages (which total a combined $84,997) as well as $198,061 in rental fees and $65,195 in lease transfer fees (NOTE: lease transfer fees were collected only during the last three months of 1991)
** = parentheses indicate a net deficit to the respective district

Refer to text of Section 7.1.2 for additional detail concerning the following notes:
(1) = cost to Town is assumed to be equivalent to taxes collected
(2) = based on information provided by the Town Highway Department for actual services rendered on the Outer Beach
(3) = cost to County is assumed to be equivalent to taxes collected
(4) = $640,000/yr applies to police services rendered to the entire Outer Beach, including non-community areas; therefore the actual cost of police services provided to the communities is less than this total; it is assumed that 50 % of the cost is applied to the communities
(5) = based on data provided by the Babylon Village School District
(6) = based on data provided by the Babylon Village Fire District
(7) = cost to library district is assumed to be equivalent to taxes collected
(8) = based on information provided by the Town regarding the total lighting district budget and the number of Town-wide lighting fixtures, and field counts of the number of fixtures in the subject communities
(9) = cost to refuse district is assumed to be equivalent to taxes collected

SECTION 8

SECTION 8
HOMEOWNER EQUITY

SECTION 8

HOMEOWNER EQUITY

8.0 INTRODUCTION

As discussed in Sections 6.1 and 6.3.3, the residential communities in the study area were developed on land that is owned by the Town of Babylon. This land has been leased by the Town directly to individual residents (or tenants) in the Gilgo Beach, Oak Beach, and Captree Island communities. Community associations that oversee residential land use activities are the lessees in the West Gilgo Beach, Oak Island, and Oak Beach Association communities. These community associations lease individual properties within their communities through sublease agreements to residents. The existing lease and sublease agreements were renewed in August of 1990 and extend through the year 2050.

This section of the report examines the conditions under which premature cancellation of the lease agreements may occur, and the conditions that apply to the non-renewal of the leases upon their expiration. Methods for providing the homeowners on the barrier and bay islands equitable reimbursement in the event of lease cancellation are also examined below. In addition, mechanisms for securing the necessary funding for such action, and the alternatives for disbursement of these funds, are also discussed.

8.1 EXAMINATION OF THE TERMS OF CANCELLATION OF THE LEASE AND SUBLEASE AGREEMENTS

8.1.1 GENERAL TERMS OF ALL THE LEASE AGREEMENTS

The lease and sublease agreements contain a number of clauses that pertain to the circumstances under which these agreements may be cancelled. In the event a lease is cancelled, whether it occurs due to non-renewal at the end of the lease term or prematurely at some point during the course of the agreement, tenants have one year from the date of termination of the lease or sublease to remove the buildings the property. This pertinent clause states that the Tenant may remove the buildings owned by the Tenant, but not the walks or bulkheads, at the end of the Term if: (1) they are removed without damaging the premises and/or the adjacent properties, unless the damages are repaired and the properties are restored to their original condition; (2) the Tenant agrees to remove all debris and construction materials, secure all utility and sanitary lines, and restore the property to an essentially vacant and unimproved parcel; (3) Tenant posts a bond with the landlord in an amount equal to the estimate of the cost necessary to restore the property to an essentially vacant and unimproved parcel; and (4) the Tenant is not in default under the lease. The ownership of buildings not removed will immediately be vested to the landlord (Town) "as is" at the end of the one-year grace period. This requirement is specified in every lease (including the master lease agreements between the Town and the community associations, the subleases, and the individual leases) and appears to apply under any situation.

The leases and subleases also contain a "right to renew" clause which states that if the tenant wishes to extend the lease, a written request must be submitted to the Town (as landlord) not less than one year from the date the existing lease is set to expire. Upon receipt of this request, the Town has three months to advise the tenant, in writing, of its willingness to extend the lease and the terms and conditions upon which this extension would be granted. The tenant then has two months to accept the offer after that the Town provides notification of its decision to renew the lease. If the tenant fails or otherwise chooses not to renew the lease, the offer would be considered rejected, and the existing lease would end as scheduled.

8.1.2 MASTER LEASE AGREEMENTS

The master leases agreements, which are established between the Town and the community associations, contain additional conditions under which the leases may be prematurely cancelled. These are discussed as follows.

A. ***Tenant's Defaults and Landlord's Remedies***

If the community association as tenant: fails to pay rent or added rent on time; improperly assigns the lease, improperly sublets all or a portion of the property, or allows another to use the property in a manner contrary to the lease provisions; displays improper and/or objectionable conduct on the property or allows another occupant of the property to do same; or fails to fully perform any other term contained in the lease agreement, the Town can issue a notice giving the community association ten days to remedy the default. If the community association fails to remedy the default within this ten-day period, the Town can correct the problem(s) at the expense of the association, charging the association for the expenses incurred as added rent. The Town also has the right to cancel the lease. Cancellation under these conditions requires that the Town provide the community association a three-day written notification stating the date the lease term will end. On that date, the lease and the association's rights as tenant under the lease will automatically end. The association must then vacate the premises, however, they would continue to be responsible for any outstanding expenses, damages or losses.

B. ***Condemnation***

If all of the property is taken or condemned by a legal authority, the community association's obligation to pay rent will end on the date the authority takes title to the property. If any portion of the property is taken, the association can cancel the lease upon notice to the Town. This notice must establish a cancellation date of not less than 180 days from the date of the notice. If the lease is cancelled, the community association is required to turn the property over to the Town together with any rent due up to the date of cancellation. Of the monies generated through the act of condemnation, the Town would receive the value of the reversion (the estimated market value of the land that remains when the leases expire) and the balance would be received by the community association and the subtenants to cover the leasehold value that would be lost upon lease termination. (Leasehold value is discussed further in Section 8.2.1).

C. ***Tenant's Right to Surrender Lease***

At any time during the term of the lease, for any reason, the community association as tenant can voluntarily surrender the lease to the Town. This lease termination would become effective as of the last day in the calendar year in which the association surrenders the lease. The association as tenant is responsible for all rent, added rent and real property taxes applicable for that year.

8.1.3 DIRECT LEASE AND SUB-LEASE AGREEMENTS

The lease agreements that are entered into directly between the Town and individual residents, and the sublease agreements established between the community associations and individual residents, contain the Tenant's Defaults and Landlord's Remedies clause and the Condemnation clause. However, under the condemnation clause in the individual leases and subleases, the tenant must notify the landlord of their intent to cancel the lease not less than 90 days (the master leases specify 180-day advanced notice) from the date of said notification. In addition, the lease agreements between the Town and individual residents contain the "Tenant's Right to Surrender the Lease" clause, which is not included in a sublease agreement. The individual lease and sublease agreements also contain some additional clauses that pertain to premature cancellation, which are not contained in the master lease agreements. These include the following.

A. ***Cancellation of Lease***

Unless otherwise stated in the provisions of the lease, any cancellation of a lease or sublease agreement must be made upon a 30-day notice to the landlord. Any rent and added rent due on the property would be calculated based on the effective date of cancellation in the event the lease is cancelled at mid-year.

B. ***Destruction or Damage to Improvements***

If the existing dwelling on a property is destroyed or substantially damaged, the tenant is authorized to promptly rebuild the dwelling in accordance with all applicable permit procedures and other existing governmental regulations in effect at the time (see Section 4.4). If the dwelling is destroyed or substantially damaged during the last five years of the term of the lease (or any extension thereof), and the Town of Babylon refuses to extend the lease for not less than an additional twenty years from the date of the destruction or damage, the tenant/subtenant has the right to cancel the lease. This cancellation would be effective as of the date of the destruction or damage. Any cancellation would require a 30-day notice to the landlord and the payment of all rent and added rent as apportioned as of the effective date of cancellation, as specified above.

C. ***No Guarantee of Access to the Premises***

If access to a leased property is permanently disrupted (such as by storms, seas, or other natural causes), the tenant has the right to cancel the lease. Cancellation requires a 30-day notice to the landlord and the payment of all rent and added rent as apportioned as of the effective date of cancellation, as specified above.

D. ***Bankruptcy of Tenant***

If the tenant or subtenant files bankruptcy or becomes insolvent, the landlord has the right to cancel the lease or sublease. This cancellation requires a 30-day notice to the tenant/subtenant. If the bankruptcy is not dismissed within this thirty-day period, the term of the lease/sublease would end effective as of the date of the notice of cancellation from the Town. The tenant/subtenant would remain responsible for payment of rent, damages, losses and expenses.

8.2 EVALUATION OF THE LEASE CANCELLATION COSTS

A request to renew the lease can be made at any time during the term of the lease, but must be requested not less than one year from the date the lease is set to expire. Therefore, the homeowner or community association is given ample time to negotiate lease renewal and advance notice in the event the lease is not renewed. Should the Town choose not to renew the lease agreements, the homeowner has one year from the date of expiration to remove the existing dwelling on the leased property. If the dwelling is not removed within this time period, the Town will take ownership. As discussed above, the master lease, lease and sublease agreements give the tenant the right to request an extension of the term of the lease. The Town has the right to refuse to renew the leases upon their expiration and does not need a specific reason to do so. Under these circumstances, the tenant is fully responsible for removing the dwelling, and the Town is not legally or financially bound to provide assistance to the homeowner.

Cancellation of the leases prior to their expiration date, on the Town's initiative, cannot occur unless the Town has identified a specific use for the lands and has determined that this public need outweighs the needs of those who presently utilize the properties. In this case, the Town would be responsible for providing financial compensation to the homeowners. Pursuant to the clause in the leases that covers condemnation, and in accordance with the General Contract Law of New York State, homeowner compensation would have to include the cost of moving the existing dwelling units off the Town-owned property and reimbursement for the leasehold value or the loss of the use of the property for the number of years remaining under the term of the lease. Alternatively, the Town may also opt to purchase the homes from the residents if it is determined that this would be a less-expensive alternative. However, the purchase price of the homes must be combined with the cost of the leasehold value.

To estimate the costs that would be incurred by the Town in the event the leases were cancelled prior to the end of their term, the value of the properties in the study area, as well as the value of the land (leasehold value), must be established. In addition, it is necessary to estimate the cost of relocating the existing structures from the study area to the mainland. For the purposes of this analysis, these costs and estimates were calculated in 1992 dollars.

8.2.1 ESTIMATION OF LEASEHOLD VALUES AND RELOCATION COSTS

A. ***Estimation of Land Use Values***

In 1990, the residents in the study area sought to renegotiate the lease agreements on the basis of economic hardship. In response to this request and as a part of the lease extension negotiations, the Town Board created a Beach Lease Review Panel. This panel was assigned to assess the fair market value of the land leases in the study area and to make recommendations for rental fee increases. The panel's assessment was based upon appraisals submitted by the Town and the community residents. In making their assessment, the panel presumed that the improvements to the properties in the study area would be valued at zero at the termination of the lease period, and that the leases would be renegotiated for a 35-year period.

Based on their analysis, the panel estimated and recommended a fair rental value for the individual properties of $3,200 per year. This value is a weighted average, derived from the information contained in the appraisals for various properties, and does make distinctions on the basis of location (waterfront versus non-waterfront), access (vehicular versus pedestrian), lot size, and other factors. This rental increase was written into the lease extension agreement to be spread out and phased in over a ten year period, commencing in January of 1991. By the year 2010, each community would pay a base rental fee of $3,200 (with the exception of Oak Island, which is a permanent seasonal community with a base rental fee of $1,600, starting in 2010). The rental fee would then be adjusted periodically over the following 40-year period, reaching a maximum fee of $6,400 by the end of the lease term, with adjustments based on changes in the consumer price index. The annual lease payment schedule is attached as a rent rider to each lease agreement (the rent riders for each community are contained in Appendix E).

In consideration of the efforts of the Town and the review panel, it was decided that the annual cost for the use of the land in the present analysis would be based upon the findings of the Beach Lease Review Panel's 1990 Final Report. Accordingly, in the event the Town were to terminate the leases prior to their scheduled expiration date, the Town would be responsible for reimbursing the homeowners the lease fee amount they would have been charged for each year remaining in the lease term. This cost would be calculated using the rental fees listed on the rent rider contained in each respective lease agreement (Appendix E).

B. *Estimation of Relocation Costs*

In addition to the annual cost for the use of the land, the Town would be responsible for reimbursing the homeowners for the cost of relocating their structures in the event of premature lease termination. This cost was estimated to be approximately $15,000 to $25,000 per unit (Emmett Drake & Sons, Inc., December 1992). This amount is based on removal by barge, and includes the costs of loading and unloading the home as well as securing the utility services on the site.

If the homes were to be moved via the local roadways, it would cost between $10,000 and $20,000 per unit. However, moving the homes in this manner would require the permission of the State to travel across the Robert Moses Causeway, and depending on the size of the structure, may require the removal of the roof. The distance of travel is also a factor that would affect the price, whether the structures were barged or moved over the road.

C. *Summary of Costs for Premature Lease Termination*

To provide an example of what it might cost the Town if the leases were cancelled early, a scenario using a termination year of 2020 has been used. Terminating all the leases in 2020 would require reimbursement for the cost of using the land for the 30 years remaining in the leases for all 415 homes in the study area. This would include the 54 homes on Oak Island, which are charged a reduced rental fee because they are summer homes, and the remaining 361 units located in the other five communities. As shown in Table 8-1, a 2020 lease termination would cost the Town an estimated $67,858,000 in total costs, including $59,558,000 in land use charges and $8,300,000 in relocation charges.

8.2.2 ESTIMATION OF DWELLING UNIT VALUES

To determine the current value of the homes in the study area, a listing of the assessed values of these structures was obtained from the Town of Babylon (S. Bartow, TOB, November 1992). Based on this information, the total assessed value of the 415 residential properties in the study area is $1,615,940 (Table 8-2), including $143,650 for the land assessment and $1,472,290 for the assessment on the dwelling units (property improvements). The current market value of the dwelling units in the study area can be determined by multiplying the assessed value of the existing dwellings by an equalization factor provided by the Town of Babylon Tax Assessor's Office (B. Anderson, TOB, December 1992). Using this method, the current market value of the homes in the study area is estimated to be $58,193,280, or $140,225 per unit. However, this may underestimate the actual value of Outer Beach homes. Based on Town records, $225,000 was the approximate average sales price of Outer Beach homes sold between August 1991 and September 1993.

To determine the total cost to the Town in the event they chose to purchase the residences rather than relocate them, the cost of the loss of the use of the land must be factored in. In addition, the residents would also be denied the use of the land if the leases were terminated prematurely. Therefore, reimbursement costs would include the estimated current market value of $58,193,280 as well as the estimated land use costs of $59,558,000. If the Town were to purchase the homes in the study area, the total cost would be $117,751,280 (see Table 8-2), which is considerably higher than the estimates calculated under the relocation scenario.

8.3 ANALYSIS OF FINANCIAL MECHANISMS FOR HOMEOWNER REIMBURSEMENT

8.3.1 POTENTIAL SOURCES OF FUNDING

To determine mechanisms for financing the reimbursement of homeowners in the study area, the Town's land use plans must first be determined. The optimal method of funding is dependent upon the Town's intention in cancelling the leases. If the Town has a specific project earmarked for this property, it may be possible to secure all or a portion of the funding required from a government agency or private organization that has an interest in the proposal. For instance, if the Town proposes the development of additional public recreational resources on the land, funds may be available from State or Federal parks departments or other government agencies that promote the establishment of such public resources. If the Town proposes to allow the land to revert back to its natural condition to retain it for wildlife preservation purposes, it may be possible to secure funds from any number of private environmental groups or from government agencies such as the U.S. Fish and Wildlife Service. Since the Town is not currently proposing the cancellation of the lease agreements, nor does it appear likely that such action will be undertaken, the current availability of public and private funding was not investigated.

8.3.2 GENERAL FUNDING MECHANISMS

In the event the Town cannot secure adequate funding through other means, monies could be raised through the issuance of municipal bonds. Three types of general bonds could apply: general obligation bonds, project-specific bonds, and/or revenue bonds, depending on the proposed use of the lands.

If the land is to be cleared in an effort to restore it to its natural condition, it is likely that the Town would fund this action through general obligation bonds, also known as general municipal bonds. These bonds are sold to the Town on the good faith guarantee that the Town would raise the tax dollars necessary to repay the bonds in accordance with the terms of their issuance. In this case, the study area lands would be used as collateral against these bonds.

If the Town plans to erect recreational facilities on the subject land, project-specific bonds could be issued against the proposed project. With this type of bond, bond investors are directly investing in the proposed project. Again, the land would be put up as collateral. Project-specific bonds are generally issued in combination with revenue bonds.

If a project that the Town is proposing involves the construction of a public facility that would generate revenues, revenue bonds could be obtained. The income generated by the proposed project, or a portion thereof, would be used to pay back these bonds. In this case, the project itself would be used as the collateral. These bonds are generally issued at a higher rate because if the project is not successful, the bank would be exposed to a loss of its investment.

8.3.3 ALTERNATIVE FUNDING MECHANISMS

If the Town of Babylon were to determine at present or in the near future that they would not be renewing the leases when they expire in 2050, or that they will be terminating the leases prior to their expiration date, measures could be taken to generate monies for future financing purposes. The Town could establish a self-liquidating fund through the segregated set-off of a portion of the lease fees that are currently being collected. This action would require that a portion of the annual lease revenues be invested in a manner that would generate interest over the course of the lease term, or through the date at which the leases would be terminated. The monies that accumulate in this fund could then be utilized to cover reimbursement costs or other necessary expenses.

8.4 LIST OF REFERENCES

Anderson, Barbara. December 21, 1992. Town of Babylon Tax Assessor's Office, Lindenhurst, New York. Telephone communication.

Bartow, Susan. November 30, 1992.Town of Babylon Data Processing Department, Lindenhurst, New York. Telephone communication.

Drake, Emmett. December 21, 1992. Owner of Emmett Drake and Sons, Inc. Moving Company, Bayshore, New York. Telephone conversation.

Final Report of the Beach Lease Review Panel, prepared in 1990 for the Town of Babylon Town Board.

Renewal and Restatement of Individual Barrier Beach Lease Agreement, Captree Island, August 14, 1990.

Renewal of Master Lease Agreement, West Gilgo Beach Association, Inc., August 14, 1990.

Renewal and Restatement of Sublease Agreement for West Gilgo Beach, August 14, 1990.

Rent Riders for the Gilgo Beach, Oak Island, Oak Beach and Oak Beach Association communities, dated August 14, 1990.

Town of Babylon Master Tax File - Summary Record for the Study Area Community Tax Districts for 1991-92, dated November 27, 1992.

TABLE 8-1

Estimates of Land Use and Relocation Costs

Land Use Costs

	Total Lease Fees for 2021 through 2050		Total Units		
Oak Island	$76,750 (1)	x	54	=	$4,144,500
Other Communities	$153,500 (2)	x	361	=	$55,413,500
				TOTAL	$59,558,000

Relocation Costs

Total Number of Units		Average Cost Per Unit (3)		Total Relocation Cost
415	x	$20,000	=	$ 8,300,000
				=============
			TOTAL ESTIMATED COST TO TOWN	$67,858,000

Source (1) Lease Agreement for the Oak Island Community, August 1990
(2) Lease Rent Riders for the West Gilgo Beach, Gilgo Beach, Oak Beach, Oak Beach Association, and Captree Island communities; August 1990.
(3) Emmett Drake, December 20, 1992.

TABLE 8-2

Total Tax Assessment for Residential Properties (1)

Community	Land	Improvements	Total
West Gilgo	24,000	274,010	298,010
Gilgo Beach -			
West	17,895	148,540	166,435
East	5,630	49,210	54,840
	23,525	197,750	221,275
Oak Island	16,955	83,660	100,615
Oak Beach -			
West	7,280	100,940	108,220
East	27,970	347,940	375,910
	35,250	448,880	484,130
Oak Beach Association	29,430	348,310	377,740
Captree Island	14,490	119,680	134,170
	======	=======	=======
TOTAL	$143,650	$1,472,290	$1,615,940

Market Value - of Improvements	$1,472,290	/	.0253 (2)	=	58,193,280
Estimated Land Use Costs					59,558,000
			TOTAL ESTIMATED COST TO TOWN		$117,751,280

Source: (1) Town of Babylon Master Tax File - Summary Record for the Study Area, November 27, 1992.
(2) B. Anderson, Town of Babylon Tax Assessor's Office, December 21, 1992.

SECTION 9

SECTION 9
PUBLIC ACCESS AND RECREATION

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PUBLIC ACCESS AND RECREATION

9.0 INTRODUCTION

Public recreational facilities encompass a large portion of the land area on Jones Island. In the immediate vicinity of the study area alone, there are approximately 1,500 acres of land designated for a wide range of passive and active recreational uses. This section of the Barrier and Bay Island Communities Study inventories these facilities and analyzes their ability to accommodate current demand. Existing levels of use are examined to determine if there is a need to expand existing facilities or develop additional facilities or services. The informal recreational use of the shoreline by the public is also assessed to determine what impact this use may have in the study area, and if it represents a need for additional services or facilities.

9.1 HISTORICAL ASPECTS OF PUBLIC ACCESS AND RECREATION

Prior to the construction of the State parks and the municipal recreational areas on Jones Island, there were no formal recreational facilities in this area. Up until about the 1880's, the Outer Beach area was utilized for fishing, shellfishing and agricultural purposes. In 1878, the Town of Babylon began granting leases in the study area to oyster planting businesses and other such commercial enterprises, as well as to residential tenants, for the utilization of the land for residential and recreational purposes. These Outer Beach leases preserved the right of the public to freely cross and re-cross the barrier and bay islands, with the exception of the months of July and August, when new salt hay sprouts were vulnerable to trampling (R. Douglas, November 16, 1992).

The first summer cottages were constructed on Oak Island by members of the Oyster Planter's and Businessmen's Association of Babylon. This association had established a club house on Oak Beach (then known as Oak Beach Island) in 1877. This clubhouse was utilized for recreation and was so popular a pastime, it inspired members to take up summer residence in the area (Douglas, 1992). Summer homes were also developed in the Gilgo Beach area and the High Hill area near Zach's Inlet (today known as Zach's Bay). The High Hill community became a popular summer beach resort around the turn of the century. Summer cottages as well as a small hotel and a few boarding houses were established in this area. Residents from the Bellmore, Wantagh and Seaford areas, and visitors from outside the area, would reach the community by way of ferry services that operated out of Bellmore. The Gilgo Beach area was inhabited by residents from the Amityville area who established summer bungalows on the beach. Around 1879, an inn was also established on Captree Island which serviced summer visitors. Aside from use by summer residents and vacationers, the area did not provide vast recreational opportunities to the general public because of limited access. The only way to get to the beaches was by a ferry service or private boat.

In the late 1920's Robert Moses, under the authority of the Long Island State Park Commission (LISPC), constructed Ocean Parkway, Meadowbrook Parkway, Wantagh Parkway, and Jones Beach State Park. The construction of these roadways, which were connected with the newly constructed Southern State Parkway, permitted easy access to the Outer Beach area. This led to the extension of Ocean Parkway to the eastern end of the Jones Island, and the development of municipal park facilities. Jones Beach officially opened on August 4, 1929 (Gorman, NYSOPRHP, October 29, 1992), and by the summer of 1932, had reached capacity attendance (Caro, 1974). This facility continued to be enlarged throughout the next decade.

In the fall of 1931, Ocean Parkway had been extended to the eastern end of Jones Island, and plans for a bridge to Fire Island were underway. The extension of Ocean Parkway required the acquisition of municipal lands by the LISPC. Oyster Bay ceded the State approximately 500 acres of meadow land. Babylon Town also granted the State ownership to approximately 1,400 acres of barrier island land, a large portion of which comprises Gilgo State Park. The construction of Ocean Parkway included the installation of roadway underpasses which enabled the Towns to develop recreational facilities along the bayside with access to the ocean. Similar underpasses had been provided at Jones Beach, which allowed access from bay-side parking areas to the ocean beaches. Five underpasses were built in the areas of Tobay and Gilgo Beaches, although not all of them are open today. Two underpasses at the J.F.K. Wildlife Sanctuary in Oyster Bay are presently overgrown with vegetation and inaccessible. The West Gilgo Beach underpass is deliberately closed in winter and opened in summer season.

In response to the increased usage of the barrier island by mainland residents and the available access to the Outer Beach area via the newly constructed roadways, the Town of Babylon developed park facilities. Cedar Beach and Gilgo Beach were opened for public recreational usage in the mid-1930's. Tobay Beach in the Town of Oyster Bay was opened for formal recreational use around 1940. At the same time, the LISPC was continuing its expansion activities, completing access to Fire Island, and in 1939 Robert Moses State Park was officially opened to the public.

The plans to expand the Jones Beach Park facilities also continued, with the LISPC acquiring ownership to the High Hill Beach area. The High Hill beach summer resort community had been established on land leased from the Town of Hempstead. The Town had issued leases to 98 residents which were set to expire in June of 1940 (Seaford Historical Society, December 14, 1992). In response to the pending termination of the leases, the majority of these homes were relocated to the study area; some were demolished. The area was then redeveloped as Jones Beach Field No. 9. A pavilion was constructed here in 1947, which was demolished in 1977. The State presently utilizes this area as a grounds maintenance facility for Jones Beach Park.

Recreation facility development continued in the 1950's, with the construction of the Captree Bridge (the Robert Moses Causeway) which provided direct access from Fire Island and Jones Island to the mainland. In 1954, Captree State Park was opened. The Town of Babylon constructed Overlook Beach and the Cedar Beach Marina facility. Since then, many of the barrier island recreational facilities have been expanded and/or upgraded to service the continuing demand by the public to enjoy the Outer Beach area.

9.2 IDENTIFICATION OF PUBLIC ACCESS LOCATIONS

As part of this study, the land uses within and in the vicinity of the study area were analyzed to determine the availability of formal recreational access, and to identify areas where the public was gaining informal access to the shoreline. Formalized areas of recreation include the various State and municipal parks in the area as well as a small number of privately-utilized recreational facilities. Informal points of access include dune walkovers, areas where boats are beached or anchored off-shore, and shoreline areas used for surfcasting. The formal facilities were examined to assess the amenities they offered and their level of uses. The informal points where the public accesses the shoreline were examined to determine how access was gained, the level of usage, and if there was any impact to the surrounding environment. The identification of locations of recreational access was made through the use of U.S.G.S. topographic maps, aerial photographs, and field surveys of the study area. Public access locations are described in the following discussion.

9.2.1 STATE PARK FACILITIES

The State of New York operates four recreational facilities in the vicinity of the study area. These parks, which provide a variety of recreational opportunities to the general public, are described below.

A. ***Jones Beach State Park***

Jones Beach State Park is located at the far western end of Jones Island, in the Town of Hempstead. This park was opened on August 4, 1929 and encompasses 2,413 acres of land, with recreational facilities located along the bay and oceanfront. Park amenities include: ocean beaches and one bayfront beach; a day-marina; picnic areas; bath houses; two swimming pools; fishing piers; a boardwalk; concession stands; a restaurant; two softball fields for league play; basketball courts; miniature golf; pitch and putt golf; a fitness trail/health walk; paddle tennis and shuffleboard courts; playground and games areas; and the Jones Beach Marine Theater (Gorman, NYSOPRHP, October 29, 1992). The beach is also utilized for surf casting in the off-season.

Jones Beach State Park is open to the general public on a year-round basis. During the summer season, which extends from Memorial Day weekend through Labor Day weekend, the entrance fee is $4.00 per car. Senior citizens have free access during the week and receive entrance fee discounts on weekends. A fee of $1.00 per person is charged for use of the two swimming pools. There is no charge to use the day-marina.

Jones Beach State Park contains twelve parking fields, with a capacity of 22,000 cars. Some of these lots are closed year-round, and additional lots are closed during the winter. The day-marina, which is located at the west end of the park, contains 30 boat slips and a pump-out facility. This marina is restricted to limited day-use only, no overnight stays are permitted.

Jones Beach is utilized throughout the year, although the heaviest usage occurs during the summer season (annual attendance information is contained in Table 9-1). In 1991, annual attendance for the park reached 8,339,477 persons. This appears to be an increase over the previous years attendance, although the State Parks Department did not keep individual records for Jones Beach until 1991. In prior years, the attendance figures for Captree and Jones Beach parks were combined. By examining the annual attendance figures for these two facilities, it is evident that attendance has been increasing since 1988. Although attendance dropped slightly during the past decade, attendance levels are once again on the rise. The combined attendance figure for 1991 of 10,439,922, is approximately equal to the 1980 attendance rate.

Activity at Jones Beach State Park increases when it opens for the summer on Memorial Day weekend and lifeguards are put on duty. However, it was stressed that park attendance and utilization is primarily weather-dependent. From Memorial Day through mid-June, usage continues to increase. The mid-June to Labor Day period is considered the height of the summer season, with all facilities at the park open and well-utilized. During this period (under optimum weather conditions) maximum attendance can reach 250,000 on a weekend day. Under these circumstances, parking lots fill to capacity. Generally, on a Saturday attendance averages between 75,000 and 100,000 persons. Sundays, being the most popular day for beach use, bring an average of up to 200,000 persons. Weekday use averages up to 50,000 people on a single day. On an average summer weekend day, some parking fields may close, but generally beach attendance comes in two to three shifts or stages, with a somewhat constant traffic flow in the lots.

B. ***Robert Moses State Park***

Robert Moses State Park was officially opened in 1939. This park encompasses approximately 1,000 acres of land on the western end of Fire Island, of which 499 acres are located in the Town of Babylon (Figure 9-1). Recreational amenities at this park include: ocean beachfront; a fishing pier; two day marinas; concession stands; picnic areas; beach shops; pitch and putt golf; games areas; and a softball field. Fisherman also utilize the Democrat Point area of the park for off-road vehicle activity and fishing (Gorman, NYSOPRHP, October 29, 1992). In addition, these beaches are popular for surfcasting in the off-season.

Robert Moses State Park is open for the general public on a year-round basis. An entrance fee of $4.00 per car is charged during the summer season, which runs from Memorial Day weekend through Labor Day weekend. Like Jones Beach, senior citizens have free weekday access and discounts on weekends. Use of the boat basins is free.

Robert Moses State Park includes four parking fields, which are each provided with a beach house building containing restrooms and lockers. Some of these lots are closed during the winter. The parking fields have a total capacity of 5,796 cars. The two boat basins each contain 35 slips and a pump-out facility. These marinas are restricted for limited day use; no overnight stays are permitted.

Robert Moses Park is utilized throughout the year, although the heaviest use occurs during the summer season. In 1991, annual attendance reached 3,652,085 (Table 9-1) which is a record high for this facility. Unlike Jones Beach and Captree State Parks, attendance at Robert Moses Park has not dropped off since 1970 and has not been irregular in the 1980's. Attendance at Robert Moses Park has been steadily increasing since about the mid-1980's (although it fluctuated slightly between 1986 and 1988), and has increased by over one million people since 1980. This cannot be said for the other two sites.

On a summer Saturday or Sunday, attendance at Robert Moses Park can reach up to 50,000 persons. Weekday attendance averages between 20,000 and 30,000 persons per day. Under optimum weather conditions, this beach has been known to reach capacity on weekends and occasionally during the week. Overflow beach traffic is then re-routed to Jones Beach. It was noted that beach traffic at Robert Moses Park does not generally occur in shifts, as occurs at Jones Beach, which exacerbates the parking capacity problems.

C. ***Captree State Park***

Captree State Park is located at the far eastern end of Jones Island. This park was officially opened on June 12, 1954 in conjunction with the opening of the Captree Bridge (Robert Moses Causeway). This park encompasses 761 acres, of which 94 acres are located in the Town of Babylon. Recreational amenities at this park include: a boat basin for open and charter fishing vessels; a bait and tackle shop; a marine fueling station; picnic areas; a restaurant; a concession stand; restrooms; a boardwalk for fishing; and a shorefront overlook park area with a fishing pier and restrooms. The eastern border of the park is also utilized by surfcasters. No swimming is permitted at this facility.

The Captree Boat Basin, which is located on the State boat channel, contains 53 berths utilized by a commercial fishing fleet and 40 transient boat berths for use by the general public. This marine facility contains a pump-out station with a 12,000 gallon per day capacity (Gorman, NYSOPRHP, October 29, 1992).

Captree State Park contains two parking areas. One area services the boat basin and can accommodate a maximum of 1,500 cars. The other parking area is located by the shorefront overlook and has a capacity of 268 cars. A $3.00 fee per vehicle is charged at the entrance gate to the park. Seniors are afforded free access on weekdays and discounted fees on weekends.

Captree State Park is different from Jones Beach and Robert Moses parks in that it is oriented towards recreational fishing and does not offer bathing beaches or opportunities for swimming. In 1991, Captree State Park was utilized by 2,100,445 people (Table 9-1), which is an increase over previous years' attendance figures. Although this park is utilized by between 1.5 to 2 million person annually, it is not over-utilized and has never reached capacity.

D. *Gilgo State Park*

Gilgo State Park is centrally located on the barrier island, between the Gilgo Beach and Oak Beach communities (Figure 7-1). LISPC originally acquired a portion of Gilgo State Park in 1928 (approximately 300 acres). Subsequent additions to this area were acquired over the following two years as the LISPC continued its eastward extension of Ocean Parkway. In total, the park encompasses 1,223 acres of land area that the State acquired for future development. To date the park remains undeveloped and is utilized for some passive recreational activity.

The New York State Parks Department allows limited activity in this park, including surfcast fishing and restricted four-wheel drive activity on the beach. A permit is required for nighttime fishing (daytime use is not regulated) and for the operation of four-wheel drive vehicles in this area. Patrons enter the park via authorized Town of Babylon access points at Cedar Beach; at the location of the old Coast Guard station, at the western end of the park; and at a point along Ocean Parkway, just west of the Oak Beach West community. A $10.00 annual permit fee is charged for fishing. An annual four-wheel drive permit costs $20.00. The State issues approximately 6,000 four-wheel drive permits annually, which can be used in all State parks that allow this activity.

9.2.2 TOWN OF BABYLON FACILITIES

The Town of Babylon operates five park facilities in the study area. These parks offer a variety of recreational opportunities to both Town residents and the general public. These facilities are described as follows.

A. *Gilgo Beach and Boat Basin*

Gilgo Beach is located on Jones Island between the West Gilgo Beach community and Gilgo State Park (Figure 9-1). The Gilgo Boat Basin is located between the eastern and western portions of the Gilgo Beach residential community. The entire park facility encompasses 65 acres. The recreational services provided include: 61 acres of ocean beachfront; restrooms and showers; a picnic area; and 57 boat slips reserved for use by Town residents. A parking lot with the capacity for 475 cars is provided along the bayside, adjacent to the boat basin. Access to the oceanfront beach is provided via an underpass which connects to the parking lot.

Gilgo Beach is the most heavily utilized Town of Babylon park site. The underpass that provides ready access to the beach makes this facility the most popular. This popularity has led to over-utilization during the height of the summer season. According to Town officials, this beach is closed regularly on weekends as the parking lot reaches capacity (Matheis, TOB Parks Department, December 14, 1992). The Town staffs the facility throughout the day on Saturdays and Sundays in the summer to monitor the parking lot and close it when it becomes full.

Attendance figures for 1991 indicate that 38,087 persons utilized Gilgo Beach between May 23rd and September 7th, for an average of approximately 488 persons per day. Patrons include residents with Town recreational permits and non-residents or residents without permits who pay the designated entrance fee. Approximately 82.5 percent of those utilizing this beach in 1991 had recreational permits. The 1991 attendance figures show the heaviest use occurring between July 1st and August 31st, with Friday being the most active day on average. Reported attendance for the weekends (Friday to Sunday) during this time period reached a maximum of 3,530, with average weekend attendance ranging between 2,200 and 3,000 persons, depending on weather conditions.

B. *Cedar Beach and Overlook Beach*

Cedar Beach and Overlook Beach are located in the central portion of the study area, between Gilgo Beach and Oak Beach (Figure 9-1). These park facilities encompass a combined total of 173 acres of oceanfront beach and upland area. The recreational amenities provided at the Cedar Beach facility, which is open to residents and non-residents, include: a pavilion containing restrooms, showers, and a concession stand; playground and picnic areas; handball courts; horseshoe pits; a basketball court; and an area for volleyball activity. Overlook Beach, which is restricted for use by Town residents only, offers: restrooms and showers; a picnic area and playground and outdoor fireplaces. A par 3, 18-hole pitch and putt golf course is located between the two beach facilities. Cedar Beach Park has a parking area which can accommodate 427 vehicles; Overlook Beach park can accommodate 846 vehicles. Summer volleyball and golf tournaments are conducted by the Town at the Cedar Beach facility.

Cedar and Overlook Beaches are not as actively used as the Gilgo Beach facility. Attendance figures for the 1991 summer season indicate that a total of 7,354 person utilized Cedar Beach, and 1,435 persons utilized Overlook Beach. These figures were reported for the period from May 27th through September 4th. According to Town officials, the reason for the lower attendance rates at these sites is the width of the beach. Apparently, beachgoers prefer narrower beaches that require less foot-travel (Matheis, TOB Parks Department, December 14, 1990). Unlike Gilgo Beach, which measured between 150 and 250 feet wide, the beach in this area was approximately 1,500 feet wide at Cedar Beach and 1,200 feet wide at Overlook Beach, as measured from the front of the respective pavilions (prior to the December 1992 storm).

At Cedar Beach, a 650-foot boardwalk was constructed, which extends south toward the shoreline, to enable easier access to the beach. A similar type of walkway was built at Overlook. According to the Town, Overlook Park was closed because the beach became too wide and patrons became discouraged from using it. This facility was reopened in 1991, after a 500-foot extension was added to the existing 250-foot walk.

The previous level of usage at these two parks is not known because the Town did not keep records of attendance. However, based on the 1991 data discussed above, as compared to the data available for Gilgo Beach, it is apparent that these facilities are not overutilized. Considering the amenities they offer, the demand placed upon both sites is quite low.

C. ***Cedar Beach Boat Basin***

The 38.7-acre Cedar Beach Boat Basin is located on the bayfront directly north of Cedar Beach Park (Figure 9-1). It is connected to this park via an underpass that was constructed beneath Ocean Parkway. The Cedar Beach Boat Basin was opened around 1959. This facility was developed on land that comprised a portion of the Ocean Parkway right-of-way and belonged to the LISPC. The LISPC granted the Town of Babylon a permanent easement on November 6, 1957 for the construction of the boat basin, the parking area and the underpass connecting to Cedar Beach Park.

The Cedar Beach Boat Basin contains 81 boat slips. Sixty five slips are located on the main dock and have electric service available. Sixteen slips are provided at a floating dock with no electric service. Restrooms, a picnic area, and 36 campsites with electrical hook-up are also included at this site. The parking area has the capacity for 213 vehicles. The 81 boat berths are available to residents and non-residents on a first come, first serve basis. No advance registration is permitted for their use, nor can they be used on two consecutive weekends. Boat berths may be utilized for a maximum of 24 hours.

The 36 campsites are also available to residents and non-residents on a first come, first serve basis. No advance registration is permitted and sites cannot be used on two consecutive weekends. Overnight camping permits can be obtained by Town residents for an annual fee of $40.00 ($20.00 for senior citizens). These permits enable Town residents to utilize the Cedar Beach campsites at a reduced daily rate. All users are charged per 24-hour period.

D. *Oak Beach*

Oak Beach is the smallest of the Town's barrier island park facilities and is located between the Oak Beach and Oak Beach Association communities, directly east of the Oak Beach Inn (Figure 9-1). This facility, which fronts on Fire Island Inlet, offers a playground, a picnic area, fishing opportunities, and a boat launch ramp. A parking area is provided with the capacity for 250 cars.

E. *Usage Restrictions and Fees*

All Town beach and park facilities on the barrier island are open between May 23rd and September 7th. The summer season, however, is considered as the period running from June 27th through September 7th. Town of Babylon residents may purchase a Resident Recreational Permit for an annual fee of $20.00 ($10.00 for senior citizens) to utilize any of these parks or beaches. This permit can be used in lieu of paying the daily use fee, enabling frequent users cost saving benefits. Daily use of Cedar, Gilgo and Overlook Beaches is free to Town residents with valid recreational permits. Non-residents and residents without permits are charge a daily fee of $25.00 per vehicle on weekends and holidays, and $15.00 per vehicle on weekdays. Non-residents are not permitted to use Overlook Beach.

A daily use fee is charged for use of the Cedar Beach and Gilgo marinas. These marinas are open on weekends and holidays between May 22nd and June 21st. During the summer season, which runs from June 26th through September 7th, they are open daily, including holidays. Boat docking permits may be purchased by Town residents at annual fee of $40.00 ($20.00 for senior citizens). A boat docking permit enables Town residents to use Town docks and marinas at a reduced daily rate.

The Gilgo Beach Marina is available only to Town residents with boat docking permits. A daily fee of $10.00 is charged Friday through Sunday and on holidays, and $7.00 is charged Monday through Thursday. There is no charge for the use of the pump-out facility located at this boat basin.

The Cedar Beach Marina is opened to both residents and non-residents. For residents with valid boat docking permits, a daily fee of $13.00 is charged for use of the main dock on Friday through Sunday and on holidays, and $10.00 on Monday through Thursday (these fees include electric hook-up). Non-residents and residents without boat docking permits are charged a daily fee of $50.00 on Friday through Sunday and on holidays, and $40.00 on Monday through Thursday for use of the main dock (including electric). Residents with docking permits only can use the floating dock and are charged $10.00 per day on Friday through

Sunday and on holidays, and $7.00 per day on Monday through Thursday. There is no charge for the use of the pump-out facility located at the Cedar Beach Marina.

Overnight camping at the Cedar Beach Marina is permitted from May 22nd through October 12th. The summer season, when the facility is open daily, runs from June 26th through September 7th. During the pre and post seasons, use is permitted only on weekends and holidays. Daily fees are $13.00 per day for residents with permits on Friday through Sunday and on holidays, and $10.00 per day on Monday through Thursday. Non-residents and residents without permits are charged $50.00 per day on Friday through Sunday and holidays, and $40.00 per day on Monday through Thursday.

Activities that occur at Town of Babylon beaches and recreation areas are regulated under Chapter 81 of the Town Code (the Beaches and Recreational Areas Law - TOB Code, December 9, 1969). This law outlines permitted uses and activities that may be undertaken in these areas, as well as prohibited activities. Specific items addressed under Article I of the law include bathing and swimming, fishing, fires, overnight parking, tents and camps, animals, soliciting, alcoholic beverages, games, littering, surfing and wind surfing, fire arms, user conduct, and traffic regulations. Article II regulates vehicular traffic on beaches. This section of the law addresses items such as access to public beaches, required permits and licenses, pedestrian right-of-way, excluded vehicles, speed limits, vegetation on beaches, and weight limitations.

9.2.3 TOWN OF OYSTER BAY FACILITIES

The Town of Oyster Bay operates one recreational facility in the vicinity of the study area. This park and its public services are described below.

A. *Tobay Beach*

Tobay Beach is located on Jones Island in Nassau County, directly west of the West Gilgo Beach community (Figure 9-1). This park is approximately 120 acres in area, encompassing both bayside and oceanfront facilities. The recreational amenities offered at this park include: an oceanfront beach with a pavilion, which contains restrooms and a concession stand; a bayfront beach; a marina; and a picnic area. The marina, which is located on the bayside, contains 135 slips with a pump-out facility. All of the slips are transient and are rented on a daily basis (Fitzgerald, TOB, October 28, 1992).

Tobay Beach contains a large parking lot with the capacity to accommodate 3,300 vehicles. Access to the ocean beachfront is provided from the parking lot through three passageways that were constructed beneath Ocean Parkway. One of these underpasses was constructed at the time the parkway was built. The other two were subsequently constructed by the Town. Restrooms have been provided in the parking area, near the underpass entrances.

Tobay Beach is open to Town of Oyster Bay residents and the general public in the off-season and on summer weekdays. During the summer season use of this facility is restricted to Town of Oyster Bay residents on the weekends. In the summer season, which runs from Memorial Day weekend through Labor Day weekend, a parking fee of $7.00 per vehicle for residents and $12.00 per vehicle for non-residents is charged. A seasonal pass is also available to residents for $20.00.

The Tobay marina is restricted to Oyster Bay residents only on the weekend. During the week it is open to the general public. Fees for marina use are based on the size of the boat and vary between $25 and $35 for residents and $35 and $40 for non-residents. According to Town officials, the weekend use restriction in the marina is strictly enforced.

Tobay Beach is well utilized in the summer season but is not operating at capacity. The parking area was expanded three years ago when the facility was becoming heavily utilized and parking was in short supply. At present, parking is not a problem and the facility is not subject to closure on weekends. The Town does not keep official records, but it is estimated that since the parking lot has been expanded weekday attendance has ranged between 4,000 and 8,000 persons, depending on the weather conditions. Weather is also a regulating factor on the weekends, when 12,000 to 18,000 persons visit the site. Attendance has been noted to occur in approximately two stages or shifts throughout the day, which helps to control capacity problems.

One problem that was mentioned with regard to the Tobay Beach facility is the reduction in the width of the beach. Over the past few years, storms have narrowed the profile, thereby reducing the amount of beach area available for use by patrons. This problem has been worsened as the result of the recent northeast storm of 11-12 December 1992.

The Tobay marina is heavily utilized on holiday weekends (July 4th and Labor Day). However, on an average summer weekend the marina only fills to approximately 60 percent of its capacity. During the week it is virtually empty, with only five to ten boats per day throughout the summer. This has been attributed to the use prohibitions placed upon non-residents. The Town is re-evaluating this policy in an effort to improve the utilization on weekends. It is suspected that the fee structure may also be prohibitively high, resulting in the poor weekday usage of this facility (Fitzgerald, TOB, October 28, 1992).

9.2.4 PRIVATELY-OPERATED FACILITIES

Two-privately operated marinas are located on the Outer Beach (See Figure 9.1). The Seaford Harbor Yacht Club is situated to the north of the West Gilgo Beach community, on a channel that runs northeast from

Tobay Beach Marina to the State Boat Channel. The Unqua Corinthian Yacht Club is situated on the west shore of West Gilgo Basin (West Gilgo Lagoon), just north of the community marina for West Gilgo Beach. Both of these facilities exist on land that is owned by the Town of Babylon and leased to the respective yacht clubs, which are granted exclusive usage rights. All improvements are owned and maintained by the respective yacht club.

The Seaford Harbor (Sea Horse) Yacht Club contains 24 berthing slips for boats of various sizes. Shoreside amenities includes a building with sanitary facilities and a small kitchen, and an outdoor barbecue area. An April 1992 report by CA describes this facility in greater detail.

The Unqua Corinthian Yacht Club is situated on 3.4 acres of shoreline and contains approximately 50 boat slips. Shoreside amenities include a building with sanitary facilities.

9.2.5 INFORMAL POINTS OF ACCESS

In addition to the officially established recreational facilities described above, there are a number of locations where the public gains informal access to either the established parks and facilities or to other sections of the shoreline in the vicinity of the study area. This informal access, which is achieved both on foot and by boat, is discussed as follows.

At the western end of the study area, there are a number of places where community residents have developed footpaths to the beachfront. Approximately five such pathways were noted during the CA field survey at the far western end of the West Gilgo Beach community (See Plate 2A). These footpaths extend through the Ocean Parkway right-of-way vegetation on the north side of the road and cross over the dunes on the south side of the road. Gaining access to the beach along these pathways requires by-passing the right-of-way fencing which borders this residential community. In some cases, ladders have been placed over the fence or holes have been cut in the fence to allow free access to the roadway. (This is discussed in further detail in Section 4.9.5).

There is an underpass located at the east end of the West Gilgo Beach community. This passageway, however, is intentionally closed off in the winter time as a protective measure against potential storm wave penetration. Therefore, residents must utilize the community's main roadway entrance, situated to the west of the underpass, to reach the beach during the period that the underpass is closed. This requires that residents cross Ocean Parkway and the dunes to access the beach, although off-season usage of the beach is much reduced compared to peak summer usage when the underpass is open.

In the Gilgo Beach community, residents are gaining access to the ocean front in the same manner as those at West Gilgo Beach. The field survey identified approximately eleven footpaths in the Gilgo Beach West community, and three in the Gilgo Beach East area. Like the ones at West Gilgo Beach, these pathways extend through the right-of-way vegetation, across the parkway, and over the dunes. Again, in some places ladders and fence holes were utilized to permit ease of access.

In the area located between Gilgo Beach and Cedar Beach, there are two locations outside of the subject communities where the public is gaining access to the oceanfront. The first location is at the head of the cove located in Gilgo State Park, to the east of the Gilgo East community. In this area, where the shoreline comes within close reach of Ocean Parkway, there is a footpath that leads from the bayside to the ocean beach. Here people either anchor offshore in the cove and take small rafts or dinghies to shore, or they beach their boats along the shoreline. From there, they follow the path across Ocean Parkway, and across the dunes to the beach. There are four additional paths that lead over the dunes on the south side of Ocean Parkway, just east of the pathway leading from the cove.

The second location east of Gilgo Beach, where access to the oceanfront is made, is in the vicinity of Hemlock Cove. Here again, boats are either anchored offshore or beached on the shoreline. The public then utilizes a series of five footpaths that lead from the cove to the beach. Each of these footpaths crosses over the dunes. Both of these cove areas appear to be heavily utilized as a means of gaining access to the ocean, as the pathways in these areas are very well defined.

Another area where off-shore anchoring and the shoreline beaching of small vessels occurs is in the vicinity of the Sore Thumb, just south of the Oak Beach West community. This area is a very popular area for informal access and recreation. On weekends during the height of the summer season it becomes crowded with boats that anchor off-shore.

Further east, at the eastern end of the Oak Beach Association community, two pathways were noted that appear to be utilized for vehicular access. One of these passageways extends from Ocean Parkway to the shoreline. This shoreline area is a popular location for fishing. Although a pile of large rocks had been placed at the entrance to each of these paths, it was evident that vehicles were driving around them and continuing to enter the area. Formal access for fishermen with passenger vehicles wishing to fish from the shore is limited to the Town's senior citizen fishing jetty and Town park at Oak Beach. The senior citizen jetty is restricted to senior citizens and Town residents, but has been used by fishermen of all ages.

The area east of the Captree Island community is also utilized for fishing. There was evidence here that cars pull off the exit ramp for the Robert Moses Causeway and gain access to the area under the bridge, along the shoreline of the State Boat Channel.

Vehicles with State-issued four-wheel drive permits are permitted access along otherwise restricted segments of the oceanfront. These vehicles can enter through designated locations at Cedar Beach and in Gilgo State

Park, east of Cedar Beach. They primarily access the area west of the Sore Thumb as well as lesser-used portions of Gilgo State Park for surfcasting.

9.3 ASSESSMENT OF THE NEED FOR ADDITIONAL RECREATIONAL AND ACCESS LOCATIONS

The public recreational facilities in the study area and in the vicinity of the study area are, for the most part, well utilized throughout the summer season. It is expected that the current level of usage at these facilities will be maintained or exceeded in the future. Some facilities, however, will continue to be utilized more actively than others. This is due to use restrictions, physical characteristics of the facilities, entry fees, and amenities available for use, among other factors.

9.3.1 STATE PARK FACILITIES

As noted in Section 9.2.1, there are four State park facilities in the vicinity of the study area: Jones Beach, Gilgo Beach, Robert Moses, and Captree State Parks. Gilgo State Park is undeveloped and utilized primarily for passive recreational purposes, including surf fishing and some limited off-road vehicle activity (Gorman, NYSOPRHP, October 29, 1992). Jones Beach is the largest facility and used by the greatest number of people. Robert Moses State Park, however, reaches capacity quite frequently during the summer season. Although some parking fields may close at Jones Beach during the summer, this park has not been closed to the public due to capacity problems. Captree State Park also has not experienced capacity problems.

As shown in Table 9-1, attendance levels at the three developed State Parks have been increasing since about 1988. Prior to that date, attendance had fluctuated but remained below reported levels for 1970 and 1980. The 1991 attendance figures have, for the first time in ten years, exceeded the 1980 recorded levels. It is uncertain whether this is an indication that attendance levels will continue to increase, but it appears likely they will be maintained at current levels.

Because State Parks are utilized by a broad user base, it is very difficult to project levels of usage into the future. Each beach or park draws visitors from different geographic areas and segments of the population. Jones Beach is utilized mostly by residents of the Towns of Hempstead, Oyster Bay and Babylon, as well as by residents from north shore communities and areas of New York City. Robert Moses State Park draws a large share of its attendance from areas further east, including the Towns of Islip and Smithtown, as well as the areas previously mentioned. Captree attracts a different variety of recreational user who is interested in fishing as opposed to the beachgoers that dominate the visitor population of the other two facilities.

Other factors that may affect attendance include the stability of current area populations and the age breakdown of the population (Lambert, LIRPB, December 28, 1992). Currently local populations are experiencing a decrease in the number of persons under the age of 18 and an increase in the number of persons over the age of 65. This demographic trend has an impact on beach attendance and may explain why 1970 levels were so high as compared to those reported for the past decade. The current population of baby boomers (those born between 1945 and 1965) are now raising families which may lead to a continuing increase in present attendance levels, but this is speculative.

9.3.2 TOWN OF BABYLON FACILITIES

The barrier island in the Town of Babylon contains five Town parks, two private yacht clubs, the West Gilgo Beach Association dock facility, and the large undeveloped area of Gilgo State Park. Of the estimated 2,234 acres that comprise the barrier island (between the county line to the west and Captree State Park to the east), approximately 1,508 acres (or 67 percent) contain recreational land uses (See Table 6-1). Residential and commercial land uses account for 7 percent (149 acres), and the remaining 26 percent (577 acres) of this land area is comprised of the Ocean Parkway and vacant, undeveloped Town-owned land.

As discussed in Section 9.2, the Town of Babylon recreational facilities offer a wide range of amenities, including bathing beaches and boat docks. The Gilgo Beach facility is the most heavily utilized, while, the other beach facilities are moderately used during the summer season. Of the 43,782 persons that utilized the three facilities between June 27 and September 4, 1991, 80 percent utilized Gilgo Beach. The remaining 20 percent used Cedar Beach (17 percent) and Overlook Beach (3 percent). An additional 3,094 were reported to have used Gilgo Beach between May 23 and June 27, 1991; the other two facilities were not open during this time period.

The numbers reported above indicate that Gilgo is highly favored to the point of over-utilization, while the other two beaches have ample capacity. This disparity is caused by the difference in the physical characteristics of these beaches and illustrates the public's desire to utilize the narrower stretch of beach. It is expected that this trend will continue. Therefore, the Town may choose to evaluate ways to encourage increased usage of the moderately-used facilities at Cedar and Overlook Beaches, thereby alleviating the demand on the resources at Gilgo Beach. The strategy for addressing this problem may include fee restructuring (see Section 9.4).

As with the State park facilities, it is difficult to estimate future use and demand for the Town facilities. However, rough estimates can be made. In total, 46,878 persons were reported to have used the Town facilities during the 1991 summer season. Because of the high cost to utilize these Town facilities without a resident recreation permit, the percentage of non-residential usage is estimated to be insignificant.

These 46,878 persons are equivalent to 23 percent of the Town of Babylon population, reported at 202,889 persons (U.S. Census Bureau, February 27, 1991). Using population growth estimates provided by the Long Island Regional Planning Board, future usage of the Town facilities can be projected. By 2010, it is estimated that the population of the Town will be 213,800 persons. Assuming a continuing rate of use of 23 percent of the Town population, it is estimated that the overall beach attendance will reach 49,174 persons by 2010. This is a 5 percent increase over the 1991 level of usage. It is estimated the 48,254 persons or 3 percent would utilize the beaches by the year 2000.

The above estimates are approximate, based on uncertain population projections, but indicate that as the total Town population increases, it can be expected that more people will use the ocean beaches. Again, it must be noted that other population characteristics affect attendance figures and, therefore, a simple linear increase in beach usage may not occur.

Section 9.3.6 contains a discussion of the implications of the above analysis with respect to the potential need for additional Town of Babylon Beach facilities in the future.

9.3.3 TOWN OF BABYLON BOAT DOCKING FACILITIES

The Town currently provides a total of 138 boat berths on the Outer Beach (81 at Cedar Beach and 57 at Gilgo Beach) for public use. Although the Town Parks Department did not report a lack of docking space or an over-utilization problem at these facilities, there is a perceived need for seasonal public docking space. Considering the large number of people who enjoy recreational boating on the Great South Bay each year, it is possible that these 138 slips may not fully satisfy the current demand.

In light of the above, CA identified a number of opportunities for the potential future provision of additional public docking space. Possible sites and opportunities considered include: the revitalization of the commercial marina and fueling facility located on the southwestern corner of the northern half of Seganus Thatch; replacement of the boat docking slips that were formerly located on the north side of Ocean Parkway, across from Oak Beach Park; conversion of the two private yacht clubs in the West Gilgo Beach area to public use; installation of additional floating docks at Cedar Beach; and use of the bulkhead in the western section of Gilgo Beach for public docking.

A 2.3 acre parcel on Seganus Thatch was once occupied by a commercial marina and fueling facility. This property, although presently in a deteriorated state, could be revitalized as an active public marina facility in the future. The Town owns the land, which had previously been leased to a private individual for commercial usage. The bulkhead and a portion of the docks are still in place, but would require major rehabilitation. Permits from NYSDEC and ACOE would also be required. The Town may wish to further evaluate this opportunity.

At present there are 16 floating boat berths and 65 permanent berths along the main dock at the Cedar Beach Marina. The Town could install additional floating dock space in this area to accommodate seasonal users. This dock space could be installed in the vicinity of the existing floating dock, or the existing dock could be reconstructed to handle additional boats.

There were previously 22 boat slips located on the north side of Ocean Parkway, at Oak Beach. According to the Town's draft Local Waterfront Revitalization Plan, these slips were removed due to unspecified safety concerns. The Town may wish to evaluate the feasibility of restoring this docking facility. It may be possible to design the slips in a manner that would not result in public safety hazards.

The Town may also consider converting the two private yacht clubs in the West Gilgo area (the Seaford Harbor Yacht Club and Unqua Corinthian Yacht Club) for public use. These two facilities are currently located on lands leased from the Town. In April of 1992, CA conducted a study of the Seaford Harbor Yacht Club for the Town, to determine the potential for conversion to public use. It was CA's conclusion that although such a conversion would be possible, it would be a very costly endeavor to upgrade the facility to meet basic requirements of public safety and use. It is expected that the same conditions would hold for the Unqua Corinthian facility. Therefore, the Town may choose to investigate less costly opportunities before pursuing this possibility.

Another potential opportunity for expanded public dock space would involve the use of the existing bulkhead, along the shoreline of the Gilgo Beach West community. This bulkhead is presently reserved for the use of the residents who live in Gilgo Beach West. A similar situation applies to the West Gilgo Beach community marina. Open public use of these resources would require removing them from the use of the community residents who currently lease these lands.

The Town would have three options for accomplishing this objective: renegotiate the leases to change the applicable provisions, which would likely be resisted by the affected residents; terminate the leases prematurely, which would likely involve substantial cost for the Town (See Section 8.2); or allow the leases to lapse without renewal when their current term expires in 2050, which would not provide a solution in the near-term. Due to the limitations of each of these alternatives, the Town may wish to investigate the more straightforward methods of expanding public dock space (discussed previously) prior to considering the use of facilities presently associated with the subject communities.

9.3.4 TOWN OF OYSTER BAY FACILITIES

Tobay Beach had been experiencing increasing pressure and was closing due to capacity problems. To mitigate these problems, the Town enlarged the parking area to accommodate up to 3,300 vehicles. This action has successfully addressed the problem of over-capacity, but it is expected that sometime in the distant future the problem may resurface (Fitzgerald, TOB, October 28. 1992). At such a time, the Town would reassess the situation and again undertake appropriate mitigative action. It is expected that use of this facility would also be controlled in accordance with population growth trends as discussed above, as well as environmental factors such as the width of the beach. As mentioned earlier, the beach has become very narrow due to storm action, reducing the overall size of the available bathing area. While the beach facilities at Tobay are well utilized, the marina was reported by the Town of Oyster Bay to be under-utilized. The Town is currently taking steps to analyze and address this situation.

9.3.5 FOUR-WHEEL DRIVE VEHICULAR USE

The Town of Babylon Department of Environmental Control and the Four-Wheel Drive Committee, a citizen's advisory group, have worked together at regulating use of the barrier beach for this activity (TOB L.W.R.P., November 1986). The Town prohibits access to certain sensitive areas, including dunes, tern colonies and the marshes, and requires drivers to have a permit. The entire beach and dune area between the Sore Thumb and the Nassau County line has been closed to four-wheel drive vehicles because of the erosion hazard. Before receiving a permit, Town residents must attend an educational course explaining barrier beach ecosystems and Town regulations. Most problems in the Town regarding four-wheel drive enforcement arise from the lack of coordination of Town and State policies. In the past, requirements on the State lands at Gilgo State Park have been fewer and enforcement was less intensive than on the Town lands. Recently, the Town and State have cooperatively operated a successful checkpoint booth between Memorial Day and Labor Day to control seasonal ingress and egress. There are occasionally conflicts with barrier beach residents, who complain of excessive nighttime noise from four-wheel drive vehicles.

In order to more effectively control the situation, the Town has proposed to the New York State Office of Parks and Recreation that regulation of four-wheel drive vehicles use of the entire barrier beach in the Town of Babylon, both State and Town owned, be performed by the Town through an easement agreement. In this way, access to the beach could be more effectively controlled, and regulations to protect the environment more uniformly enforced.

9.4 SUMMARY OF FUTURE RECREATIONAL NEEDS

Analysis of the available data for the utilization of the existing public recreational facilities reveals that, although it appears that certain parks are heavily utilized during the summer season, the need for additional park facilities does not seem apparent. The current use of certain sites needs to be evaluated in order to make the necessary adjustments or alterations in services or fee structures to mitigate existing capacity conditions. At the same time, appropriate changes could be made at facilities that are under-utilized to encourage increases in facility usage. Almost every Town facility permits non-resident utilization by the public, and the State parks are open to anyone; therefore, public access is not being openly restricted. However, some Town of Babylon and the Town of Oyster Bay facilities charge relatively high fees for non-resident use, which may act to limit use of these facilities by non-residents.

In the study area, it is evident that although Gilgo Beach is receiving heavy use during the summer season, other Town of Babylon park facilities are not being over-utilized. Based on an assessment of the data provided by the Town, Cedar and Overlook Beaches are being moderately utilized. Overlook Beach, which is restricted to residents only, is the least utilized site. During the summer 1991 season, only 1,435 persons were reported to have used this beach. In response to this disparity, it is recommended that the Town further investigate current facility usage and development strategies for improving the use of the lesser-utilized beaches. This is especially important in light of the potential for population growth, which may place additional demand on Gilgo Beach as well as the other two facilities.

The fee for non-residents or residents without recreational permits to use any of the outer beaches is $25.00 on weekend days and holidays, and $15.00 on weekdays. To encourage increased use of Cedar Beach, the non-resident fee could be lowered. The non-resident use restriction of Overlook Beach could also be lifted. Other such mitigative approaches should be evaluated by the Town in an attempt to improve the utilization of these facilities.

The existence of the subject residential communities was also assessed in terms of public access. Vehicular access to the barrier communities is restricted by public parking limitations in the interior of the residential areas. Public parking is available in the vicinity of some of the communities (e.g., Gilgo Beach and Oak Beach), while other communities (Captree Island and West Gilgo Beach) are remote from public parking areas. Oak Island lacks vehicular access, and can only be visited by watercraft. The bay-side communities do not contain the type of features (especially sandy beaches) that usually prompt visits to the barrier island. In addition, there are a number of bay-side parks nearby (most notably Captree State Park) that are presently not utilized to capacity. The Oak Beach communities front on the ocean-side shoreline of the barrier, but sufficient access is available in the vicinity of these communities to conclude that additional access points in the immediate area are not required.

It was noted that informal access is occurring in areas that contain dunes and other sensitive resources. This informal access is generally the result of boaters seeking ingress to the oceanfront from the bay or of fishermen seeking access to portions of the shoreline not actively open to the general public. The portions of the study area where informal access is occurring should be more closely evaluated by the Town and State to determine if more formalized means of access could be provided. This would include dune walkover ramps and possibly fishing piers or boardwalks to accommodate these shoreline users.

As discussed in Section 9.2.5 and indicated in Figure 9.1, extensive informal access to the shoreline is occurring in the vicinity of the study area. Although this indicates some need for additional formal modes of access, it would be aimed at accommodating other types of recreational users (i.e., boaters and bayside fishermen) rather than beachgoers who access the beach by car and utilize formal park facilities. The Town should further investigate the extent to which informal access is occurring, and for what purposes. Physical approaches to address the needs of these users must then be determined. Additional jetties could be utilized for fishing in the inlet or bayside fishing piers could be constructed.

At the same time that the Town is investigating methods for improving shoreside recreational access, the need for additional public docking space must also be assessed. As discussed in Section 9.2.4, there is a perceived need for more public docks and marinas and there are a number of ways this need could be addressed. Further study in this regard is required.

9.5 STATE POLICY FOR PUBLIC ACCESS AND RECREATION MANAGEMENT

9.5.1 CMP PUBLIC ACCESS AND RECREATION POLICIES

As discussed in Section 6.4, the New York State Department of State prepared a statewide Coastal Management Program (CMP). This program was put into place through the enactment of Article 42 of the Executive Law - The Waterfront Revitalization and Coastal Resources Act (WRCRA). WRCRA provided a set of 44 enforceable policies which address important issues affecting coastal areas. Federal and State actions undertaken within the CMP area boundaries must be consistent with these policies. Four of the 44 policies apply to public access and recreational concerns. These are described as follows.

A. ***Policy 19***

Policy 19 of the State CMP requires that the level and types of access to publicly owned water-related recreational resources and facilities be protected, maintained and increased. Efforts should be taken to ensure that these resources and facilities may be fully utilized in accordance with reasonably anticipated public recreational needs and the protection of historic and natural resources.

This policy focuses on improving and increasing public access to the recreational resources and facilities of the coast, such as public beaches, parks, fishing piers and boat launch sites. This is seen as a key element in the management of coastal areas. Development, private use or ownership of land, natural shoreline topography, inadequate public transportation, limited parking facilities, and non-resident restrictions, are all factors which singly or in combination can restrict public access to existing recreation resources. This policy calls for achieving a balance between providing adequate access to a resource or facility, encouraging full and reasonable use of a resource or facility, and protecting natural resources. It applies to communities with existing or planned public water-related recreational resources. Access issues include such things as inadequate access roads, lack of public transportation, physical barriers created by highways or other development, poor signage or public awareness, and limitations imposed by the cost of using a facility, including user fees, parking fees and general transportation costs.

B. ***Policy 20***

Policy 20 of the State CMP requires that access be provided to the publicly-owned foreshore and to lands immediately adjacent to the foreshore or the water's edge that are publicly-owned. It further requires this access to be provided in a manner compatible with adjoining uses, and that public lands be retained in public ownership.

Access to the publicly-owned lands of the coast can be provided for numerous activities and pursuits which require only minimal facilities for their enjoyment, such as walking along a beach, bicycling, birdwatching, photography, nature study, beachcombing, fishing, and hunting. The application of this policy does not have to depend on the existence of specific public recreation resources and facilities along the waterfront. So long as there is publicly-owned waterfront in a community, including the foreshore, the obligation exists to provide access for whatever activities are appropriate to each particular stretch of public waterfront.

C. ***Policy 21***

Policy 21 of the State CMP requires that water dependent and water enhanced recreation be encouraged and facilitated, and given priority over non-water related uses along the coast, provided it is consistent with the preservation and enhancement of other coastal resources and takes into account demand for such facilities. In accommodating such activities, priority shall be given to areas where access can be provided, by new of existing public transportation services, to existing recreational opportunities on the coast and to those areas where the use of the shore is severely restricted by existing development.

Water-related recreation includes such activities as boating, swimming, and fishing. In addition, certain activities are enhanced by a coastal location and can increase the general public's access to the coast.

Facilities that offer such as pedestrian and bicycle trails, picnic areas, scenic overlooks and passive recreation areas that take advantage of coastal scenery, are encouraged.

D. ***Policy 22***

Policy 22 of the State CMP requires that development, when located adjacent to the shore, provide for water-related recreation as a multiple use. This is essential whenever such recreational use is appropriate in light of reasonably anticipated demand for such activities.

Coastal areas are considered New York's most important outdoor recreational resource. Their appeal and significance creates several concerns. Principal among these are: 1) determining how the demand for shoreline recreation can be met while ensuring that other land and water use needs are accommodated, and 2) protecting the natural resource base. Many developments present practical opportunities for providing recreation facilities as an additional use of the site or facility. Therefore, whenever developments are located adjacent to the shore they should, to the fullest extent permitted by existing law, provide for some form of water-related recreation use. The only exceptions would be if there are compelling reasons why such recreation would not be compatible with the development, or a reasonable demand for public use cannot be foreseen.

9.5.2 APPLICABILITY OF THE STATE PUBLIC ACCESS AND RECREATION POLICIES TO THE STUDY AREA

As a means of implementing the State Coastal Management Program, local governments are given the opportunity to address the problems and opportunities in their coastal areas, in full partnership with the State, through the preparation of a Local Waterfront Revitalization Program (LWRP). Since municipalities have primary authority for directly regulating land use, an LWRP would allow them to refine and supplement the State CMP by incorporating local needs and objectives. In areas where State approved LWRP's are in place, all actions, including State and Federal actions (e.g., direct actions, and state and federal funding and permit actions), must be consistent with the policies contained in this program.

In the absence of an approved local program, the State retains full responsibility for the application and enforcement of the CMP. Unless an action undertaken in the study area requires some level of State or Federal approval, the review of Town actions for consistency with the State policies would not occur. Should the Town propose to improve or expand existing public access to recreational facilities, or should new facilities or shoreline development be planned, these proposals would not be reviewed for consistency with the State CMP unless a permit or some other form of approval was required from a State or Federal agency (e.g., a tidal wetlands permit from NYSDEC). Without an approved LWRP, there is no mechanism for local projects in the study area to be reviewed for consistency with the State policies.

Presently the Town of Babylon does not have an approved LWRP. The Town has the opportunity at any time in the future to undertake this program.

9.5.3 CONFORMANCE OF STUDY AREA DEVELOPMENT PATTERNS WITH THE STATE POLICIES

The Town does not presently have an approved LWRP, but it is possible that such a program would be implemented in the future. At that time, development and other land use actions proposed in the study area would be subject to local consistency review. Although development actions are not currently reviewed for consistency, except in cases where State or Federal permits or approvals are required, the development patterns in the study were examined to determine if past activities comply with the State public access and recreation policies.

A. ***Policy 19***

Policy 19 requires that public access to the shore be protected, maintained and increased, and that public recreational resources be fully utilized. There are presently three Town park facilities in the study area which occupy 277 acres. In addition, 1,223 acres of undeveloped beach and upland area comprise Gilgo State Park. Only 149 acres in the study area is developed with residential and, to a minor degree, commercial uses. The Town has generally complied with this policy. Although roadways in the study area are good, with no existing barriers preventing access to the shore, there is no public transportation to this area from the mainland. The fees for non-residential use of Town parks may also limit use by non-residents. However, the Town has essentially provided adequate and unrestricted access to a large part of the study area shoreline.

B. ***Policy 20***

Policy 20 requires that access to publicly-owned foreshore and adjacent land be provided. It further requires that land be retained in public ownership. Development in the study area has, for the most part, conformed to this policy although the Town has permitted residential development on the barrier. As outlined in Section 6.0, the Town and the State own all of the land in the study area, (some bay islands are owned by the County). No land in this area is held in private ownership. With respect to the residential land use, this development occupies only 7 percent of the total land area on the Town of Babylon portion of the barrier island. This development is not blocking access to the shore, or preventing the general public from utilizing the oceanfront. Although the Oak Beach communities are located along the shorefront, there are still adequate opportunities for the public to access and enjoy coastal resources. The three Town parks and Gilgo

State Park, provide access to both the ocean and bay shorelines for bathing, fishing, and boating activities.

C. ***Policy 21***

Policy 21 requires that water-dependent and water-enhanced recreation be encouraged and facilitated, and given priority over non-water related uses along the shore. By permitting the establishment of residential development in the study area, the Town has not fully complied with this policy. However, this development only comprises a small portion of the total land area. Much of the remaining area has been developed with both passive and active recreational uses.

D. ***Policy 22***

Policy 22 requires that development along the shore provide water-related recreation as a multiple use. This policy is more oriented to private development projects built along the shore. In many cases private development restricts public use and access to the shoreline. In the study area, although private homes have been built on public land along the shore, these homes are not directly restricting access to the shore. Ample opportunities have been provided by the Town for the public to enjoy coastal resources. Three Town beaches and two boat basins, (as well as the large area of State parkland) are available for passive and active recreational activities.

9.6 REFERENCES

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TABLE 9-1

ANNUAL ATTENDANCE STATISTICS FOR THE STATE PARKS

YEAR	FACILITY	ATTENDANCE
1960	Jones Beach/Captree	11,163,500
	Robert Moses	136,000
1970	Jones Beach/Captree	13,190,600
	Robert Moses	2,387,000
1980	Jones Beach/Captree	10,436,211
	Robert Moses	2,445,140
1981	Jones Beach/Captree	8,456,181
	Robert Moses	2,245,011
1982	Jones Beach/Captree	8,604,686
	Robert Moses	2,348,200
1983	Jones Beach/Captree	8,655,426
	Robert Moses	2,456,815
1984	Jones Beach/Captree	7,430,363
	Robert Moses	2,308,719
1985	Jones Beach/Captree	8,277,164
	Robert Moses	2,564,253
1986	Jones Beach/Captree	8,280,580
	Robert Moses	2,729,472
1987	Jones Beach/Captree	10,036,665
	Robert Moses	3,098,695
1988	Jones Beach/Captree	8,151,143
	Robert Moses	2,824,039
1989	Jones Beach/Captree	9,320,028
	Robert Moses	3,107,292
1990	Jones Beach/Captree	9,664,769
	Robert Moses	3,306,374
1991	Jones Beach	8,339,477
	Captree	2,100,445
	Robert Moses	3,652,085

Source: G. Gorman, New York State Office of Parks, Recreation and Historic Preservation, November 6, 1992.

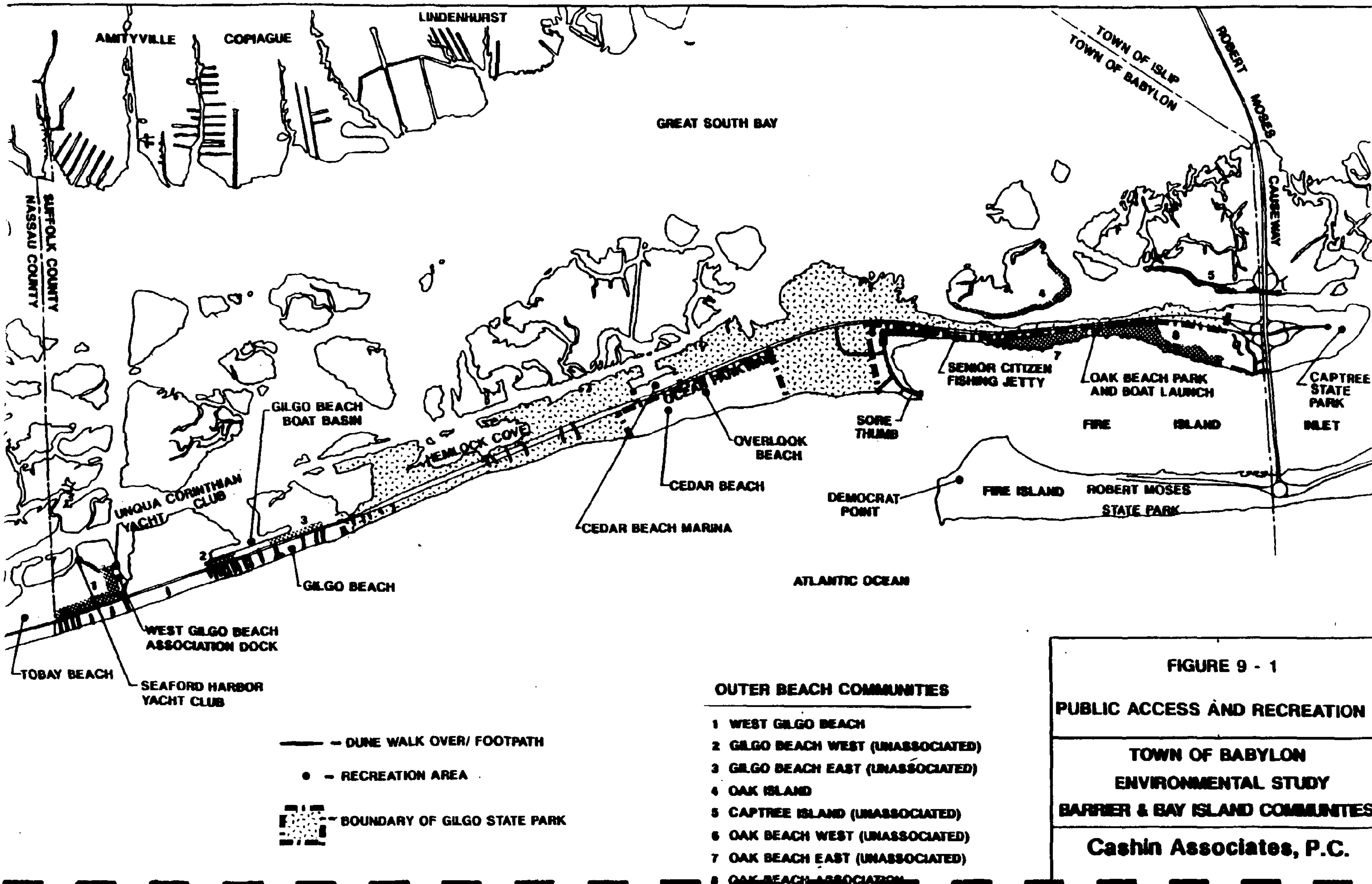

FIGURE 9 - 1

PUBLIC ACCESS AND RECREATION

TOWN OF BABYLON
ENVIRONMENTAL STUDY
BARRIER & BAY ISLAND COMMUNITES

Cashin Associates, P.C.

SECTION 10

SECTION 10
CONCLUSION

SECTION 10

CONCLUSION

10.1 INTRODUCTION

The preceding nine sections of this report contain a detailed analysis of the seven study elements that were specified by the Advisory Committee in the scope of this study. Under each study element, the discussion centered on the existing conditions within and in the vicinity of the subject communities, the impacts that have resulted from these communities, and measures that could be implemented to mitigate identified impacts. Below is a synopsis and further analysis of the impacts (Section 10.2), unavoidable adverse impacts (which are discussed separately in Section 10.3), beneficial environmental effects of the subject communities (Section 10.4), and mitigation measures (Section 10.5) that have previously been discussed. The main purpose of these four sections is to unify the primary findings of this study, which have been formulated under the individual study elements. The comprehensive scope of this summary will allow the interdependence of the study elements to be more readily shown than in the individual sections that are presented above.

The final section of this report contains recommendations for the implementation of measures to mitigate the impacts that have resulted from the presence of residential development on the Town of Babylon's barrier and bay islands. This integrated plan for the management of the Outer Beach communities will contain some comprehensive strategies that have not been discussed previously in this report (e.g., the establishment of homeowners' associations in the three communities that are presently unassociated). Further elaboration on management options that have been examined under individual study elements is also discussed in Section 10.6.

10.2 SUMMARY OF IMPACTS

The introduction of houses into an area that was previously undeveloped will generally impact the natural environment to some degree. Among the typical consequences of human habitation are the release of certain contaminants into surface waters and groundwater, the disturbance of natural landforms, and the displacement of sensitive wildlife and vegetation. Residential developments can also place an added burden on community services, and may occupy lands that otherwise might be used to satisfy public recreational needs. All of these factors were examined in the present study in order to gauge the effects that residential development has had on the environment of the Town of Babylon barrier and bay islands.

Overall, this study has revealed that the six residential communities which were the subject of this investigation have not had large scale adverse impacts on the barrier and bay island environment. Although, clearly there have been some negative effects of the development of the Outer Beach, the existence of this development has also generated some benefits (see Section 10.4).

This study has revealed no evidence that the Outer Beach communities have caused significant deterioration of the quality of surface waters in the surrounding area. It is likely that some contamination is released to Great South Bay from septic effluent, especially during high tides and storm events. However, the entire Bay suffers from water quality problems during extreme weather, particularly due to contaminants carried from the Long Island mainland. The design of the subject communities has incorporated effective mitigation for potential surface water quality impacts; there is very little area of impervious surfaces, and individual home sites are generally surrounded by wide buffers of vegetation rooted in sandy soils. Thus, precipitation that falls onto the study area generates very little stormwater runoff (which is the chief contributor of pollutants to Great South Bay), and the runoff that does result generally infiltrates into the ground before reaching the bay.

Septic effluent released from the subject residences via subsurface sewage disposal systems has adversely affected groundwater quality in the study area. However, these impacts have been limited to the upper portion of the aquifer; contaminants do not penetrate to the drinking water resources of the deep aquifer, due to the presence of a salty groundwater layer that separates the shallower and deeper layers of freshwater.

The presence of residential development on the Outer Beach has likely caused some penetration of saltwater into the deep aquifer. According to the Suffolk County Department of Health Services (SCDHS), numerous wells that were drilled to the deep aquifer to satisfy potable water needs of the residents of the subject communities have been abandoned. As the casings of these wells succumb to corrosion due to contact with the salty layer of groundwater, pathways are created for saltwater (and other contaminants) to penetrate to the freshwater of the deep aquifer. The SCDHS considers this to be a potentially serious threat to drinking water resources.

The potential for damage caused by a severe coastal storm is the most serious threat that faces the residents and property of the Outer Beach. All six residential communities lie entirely within the designated boundary of the 100-year flood plain, and fully 81 percent of the individual houses are situated within an area (i.e., the V zone) identified as being susceptible to significant wave action during the 100-year event. However, only 42 percent of the houses in the study area conform with the minimal flood prevention standard for first floor elevation, and it is estimated that fewer than 5 percent of the houses in the V zone comply with strict structural requirements for resistance against wind and storm waves.

Despite the potential for the subject communities to incur significant damage due to severe coastal storms, very little damage has actually been sustained in recent memory. In fact, the residences in the study area have escaped virtually unscathed from recent storms which have wreaked extensive destruction in other areas of Long Island. This may give some residents within the study area a false sense of security regarding their susceptibility to coastal storms, which increases the likelihood that some residents will not react appropriately to official directives during a storm emergency. The possible consequences of such a situation would be increased property damage, and unnecessary injuries and even deaths.

The study area and vicinity contains large tracts of vacant land, including approximately 82 building lots within the subject communities that are designated for residential use and which were determined by CA to be potentially developable. The construction of houses on these properties would result in a significant increase in the number of residents in the study area and a concomitant increase in the level of impact caused by the subject communities. Alternatively, these lots can be held in reserve for the relocation of existing homes from sites that are more susceptible to storm damage. The Town believes that the current development density (415 homes in the study area) achieves an appropriate balance between development and the environment.

The cost-benefit analysis performed by CA indicates that the Town of Babylon presently receives a significant net monetary benefit from the subject communities. This benefit will increase as the annual rental fee escalates during the term of the current leases. It is important to note, however, that the Town would likely incur substantial direct and indirect relief costs in the event of a coastal storm that causes substantial damage to the subject communities. Thus, the assessment of positive financial impacts would have to be re-evaluated if large-scale, storm-induced structural damage were to occur.

The current leases have a term that extends to the year 2050. The Town is vested with the authority to terminate the leases prematurely, but only if such action would accomplish a specific beneficial objective. Since the leases legally bind the Town to provide the lessees with the use of Town-owned property, in return for the payment of a predetermined rental fee, the Town would be required to compensate tenants for premature termination of these leases. This compensation, which would include house-moving expenses and remuneration for the loss of the use of the property, could be prohibitive, especially if action is undertaken early in the lease term. The Town's costs would become lower as termination is effected nearer to the lease expiration date; however, the potential benefits of lease termination would also diminish. Thus, it appears from the homeowner equity analysis performed by CA (which did not consider possible legal costs incurred in the likely event of a breach of contract suit by the residents) that the potential benefits that would be derived from premature lease termination would not justify the costs that would be applied to the Town.

In general, New York State coastal policy requires that public land be used for public recreation, open space, or wildlife habitat. The State considers that new residential development is not an acceptable use of public land, even if the controlling entity maintains ownership. However, in the case of residential development that predates the implementation of the NYS Coastal Management Program, as applies to the subject communities, the applicability of State policy is not as apparent. In the absence of significant impacts to natural resources and/or community services, the presence of pre-existing residential communities would be clearly inconsistent with State policy only if such development interferes with the expansion of public recreational opportunities and open space.

Although the barrier beaches in the vicinity of the study area (i.e., Jones Island and the western end of Fire Island) receive the heaviest usage of all of Long Island's public recreational facilities, there currently is no demonstrated need for the creation of additional facilities, nor is it apparent that this need will arise in the foreseeable future. Although certain public recreational facilities (particularly Jones Beach State Park and the Town of Babylon's Gilgo Beach) are experiencing capacity problems, other facilities operate well below capacity. Importantly, even if it was determined that additional land was needed for park land expansion, none of the lands within the subject communities would provide an ocean beach, which is the type of facility that is in greatest demand. Furthermore, although there may be a need for additional public marina space, there appear to be a number of alternatives that should be investigated prior to examining the possibility of converting the community dock space at West Gilgo and Gilgo Basins to public use. Thus, despite the fact that the subject communities occupy public land, the existence of these communities does not appear to be limiting opportunities for public recreation and the enjoyment of open space.

10.3 UNAVOIDABLE ADVERSE IMPACTS

As noted above, the potential for damage caused by a severe coastal storm is the most serious threat that faces the residents and property of the Outer Beach. Although certain measures can be implemented to lessen the magnitude of potential property damage and injuries (see Section 10.4), complete elimination of the threat is not possible.

The susceptibility of the Outer Beach communities to storm-induced damage is largely subject to factors that may vary significantly over time. In particular, the degree of protection afforded the West Gilgo and Gilgo Beach communities is dependent on the condition of the oceanfront beaches and dunes along that segment of the barrier. At the present time, these communities are especially vulnerable due to the substantial loss of beach and dune material caused by recent storms. The ability of this shoreline section to resist overwash (or even barrier breaching) has been greatly diminished by these episodes of erosion. Consequently, storms that may occur before the beach and dunes are restored (either artificially, or gradually through natural processes) are more likely than ever to cause damage to the back barrier communities.

The Oak Beach communities are, similarly, more susceptible to storm damage than ever before due to the recent deterioration of the Sore Thumb.

However, whereas it is likely that over the short-term all feasible action will be implemented to restore the West Gilgo and Gilgo shorelines due to the overriding urgency of protecting Ocean Parkway and preventing the formation of a new inlet, no such priority has been applied to the restoration of the Sore Thumb. As a result, it is possible that necessary maintenance of the Sore Thumb will never be undertaken. With the diminishing ability of the Sore Thumb to deflect tidal currents away from Oak Beach, the communities at that location will likely experience accelerated shoreline erosion and increasing susceptibility to storm-induced damage.

10.4 BENEFICIAL ENVIRONMENTAL EFFECTS OF THE SUBJECT COMMUNITIES

Despite the fact that the residential development in the study area has impacted the environmental resources of the Outer Beach (to the degree specified in Sections 10.2 and 10.3), the presence of the subject communities also appears to have provided indirect environmental benefits. Specifically, CA's investigation revealed that residents of the study area have a generally high level of appreciation for the Outer Beach environment, due partly to individual interest that arises directly from being in proximity to these resources, as well as to the programs of such organizations as Save the Beaches Fund, Inc. (STBF). This appreciation for the local environment has translated into a number of activities that are directed at enhancing and preserving the environment.

STBF, in particular, has been instrumental in the effort to increase public awareness and participation in local environmental issues. This not-for-profit organization is based in Oak Beach, and draws its membership and officers largely from the Outer Beach communities. The following is a partial listing of STBF projects that have been undertaken in the past few years:

- participation in field education programs for local school children in September 1991;
- participation in a beach cleanup at Gilgo Beach in September 1991;
- distribution of periodic newsletter to 110 individual and family members (membership as of summer 1992);
- selection of three sites for osprey nesting, and the erection of three nesting platforms;
- financial support and coordination with the Town for a storm drain stencilling program, to minimize the use of storm drains as sites for waste disposal;
- assistance to the Nature Conservancy in the annual roping of habitat areas for protected shorebirds;

- engagement in an effort to obtain NYSDEC commitment to extend the bay side boardwalk at Cedar Beach to the water's edge, for fishing, environmental education, and passive enjoyment of scenic resources; and

- voluntary cooperation with the Suffolk County Vector Control office in a long-term program for the Great South Bay salt marshes, including the collection of larval samples and the treatment of mosquito breeding sites.

10.5 SUMMARY OF MITIGATION MEASURES

Below are summarized the primary measures that have been formulated to mitigate the impacts of the subject communities. Refer to the respective sections of the report under the appropriate study elements for a more detailed discussion of any given measure.

- The number of residences in the study area should be frozen at no more than its current level of 415. The Town Board should explore legal mechanisms to ensure that this policy is retained.

- No construction activity should be permitted in the study area which involves the direct discharge of stormwater to surface waters or tidal wetlands. Leaching pools should be required whenever an action will result in a potential increase in the long-term discharge of stormwater to surface waters or tidal wetlands.

- All activities within the subject communities should be undertaken so as to maintain or enhance the existing vegetative buffer areas.

- Permeable surfaces should be required for all new paved areas within the subject communities that are 300 feet or less from a surface water body or tidal wetland (e.g., gravel for vehicles and wooden boardwalks or gravel for pedestrians).

- Appropriate sediment and erosion control measures (e.g., hay bales, silt fencing, temporary seeding, etc.) should be implemented for all activities within the subject communities that will result in exposed soils that can potentially be carried to nearby surface waters or wetlands.

- Boaters in the subject communities should be made aware of the locations of wastewater pumpout stations in the vicinity of the study area.

- Where possible, private homeowner wells used for potable water supply should be replaced with year-round community supply systems that service more than 5 residences.

- Private wells in the study area, which presently are not subject to any monitoring requirements subsequent to the mandatory pre-installation testing, should be monitored on a routine basis to ensure acceptable water quality.

- There should be increased governmental monitoring of the closure of private wells in the study area, which would prevent them from becoming a conduit for the downward migration of saltwater and other contaminants. Enhanced oversight of the installation of new private wells would ensure that these wells meet minimum standards of construction, which would prolong their life and decrease the rate at which wells are abandoned in the future.

- Hurricane preparedness education should be stepped up and provided on an annual basis to residents of the subject communities. It is recommended that a pamphlet be designed to serve the multiple purposes of increasing public cognizance of the study area's susceptibility to severe coastal storms (particularly hurricanes) and instructing residents on steps to take in the event of an impending storm. The Town's current hurricane awareness pamphlet does not contain adequate information on the former topic.

- In an effort to increase the level of flood insurance coverage, the Town should distribute pertinent educational materials to the affected residents to explain the objectives of the National Flood Insurance Program, and should highlight the advantages of having flood insurance versus other possible means of disaster relief.

- The Town should maintain its commitment to participating in the Community Rating System of the National Flood Insurance Program, and should investigate options for expanding its level of participation. For example, the availability of sources of revenue to fund the conversion of existing houses to meet FEMA requirements should be pursued.

- Beach nourishment and dune restoration activities along West Gilgo and Gilgo Beaches should be continued into the indefinite future. The State's mechanism for obtaining the funding to support their share of the costs of the Fire Island Inlet dredging/beach nourishment project should be reviewed and strengthened, if possible, through legislation that <u>requires</u> dredge spoil from the inlet to be used for beach nourishment purposes.

- Mechanisms for funding the restoration of the Sore Thumb should be investigated.

- The environmental review process for the replacement of existing houses on the Outer Beach with new construction should be streamlined to the maximum extent possible without sacrificing the "hard look" required under the State Environmental Quality Review Act. The environmental benefits that are derived from such conversions (e.g., improved quality of septic effluent due to the installation of a new subsurface sewage disposal system, and enhanced storm damage resistance due to construction that meets

FEMA standards), especially during the early years of the current lease term, should be carefully taken into consideration during project review.

- A more vigorous dune management plan should be implemented to preserve the important erosion protection capabilities and ecological values of these features. This plan should consist of: increased signage and fencing to direct traffic away from unprotected dunes, the construction of walkways at strategic locations over the dunes, intensified enforcement of the existing ban on foot traffic across the dunes, and a redoubled public education effort.

- Water craft speed limits through the State Boat Channel in the vicinity of the Captree Island community should be vigorously enforced to minimize wake-induced shoreline erosion.

- The Town should investigate and implement means of shifting the beach-going population from the heavily utilized facility at Gilgo Beach to the two currently underutilized facilities at Overlook and Cedar Beaches.

- The Town of Babylon should further investigate the need for additional public dock space. If a real need exists, the Town should explore alternatives for increasing the number of public boat slips through the expansion of existing public facilities, the re-establishment of presently abandoned facilities that had been utilized in the past, and the conversion to public use of private yacht clubs that currently occupy land leased from the Town.

10.6 SUMMARY OF MANAGEMENT RECOMMENDATIONS

10.6.1 COMMUNITY ASSOCIATIONS

In addition to the individual mitigation measures outlined above, the main element of the recommended management strategy for the study area would be the establishment of homeowners' associations in the three communities (i.e., Gilgo Beach, Captree Island, and Oak Beach) which are presently unassociated. CA's investigation revealed that the existence of a community association appears to afford a greater degree environmental protection than exists in the absence of such an organization. The primary basis for this conclusion is the qualitative observations that were made during the course of the subject investigation.

There are several factors that appear to have contributed to the apparent enhancement of general environmental conditions in the associated communities, versus the unassociated areas. The community bylaws that govern activities in the associated areas place additional restrictions on residents of these communities, in terms of aesthetics and other environmental factors, that do not apply to residents of the unassociated communities. For example, accessory structures (such as garages) are prohibited in certain associated areas, which limits the extent of site disturbance. Furthermore, community associations tend to exert informal pressure on community members to conform with acceptable rules of conduct, which is not possible in the absence of oversight on a community level.

Homeowners' associations also tend provide a stronger sense of community than exists in unassociated areas, which encourages various types of behavior that serves to protect and enhance the environment in the study area. For example, CA found during its field investigation that, in general, residents of the associated areas tended to be more likely to inquire as to the reason for our presence in their communities. Since strangers often engage in environmentally detrimental behavior, such as dumping and the disturbance of habitat areas, this type of community watch activity discourages such behavior. Furthermore, the existence of a homeowners' association also facilitates the implementation of projects on a community-wide scale. Since all residents contribute financially to the association, money is readily available for such projects. Additionally, regularly scheduled meetings of the association boards allows residents of these communities with a mechanism to express opinions and make recommendations for improving conditions.

10.6.2 DEVELOPMENT INTENSITY

The Town has indicated that the extent of residential development in the study area will not be expanded beyond the current level of 415 houses, although there are an estimated total of 82 vacant lots that are considered to be developable. This policy is consistent with the goal of minimizing potential impacts to the environment caused by the subject communities.

Although the use of vacant lots for the development of additional housing units in the study area would be contrary to Town policy, no such limitation exists with regard to the use of these lands for the relocation of existing houses. CA supports such action, which can provide a number of environmental benefits. For example, development that is presently located in areas which are most susceptible to coastal storm damage can be shifted to more protected sites, especially in response to a destructive storm event. In addition, houses that sit in or adjacent to important habitat areas can be relocated to less sensitive areas.

CA's assessment of the number of developable lots in the study area was based on a preliminary qualitative analysis of site conditions. The usability of any individual property for redevelopment purposes, particularly those lots which have been identified as requiring some site engineering, must be evaluated in detail on a lot by lot basis.

10.6.3 PUBLIC ENVIRONMENTAL AWARENESS EDUCATION

Enhanced public education is specified as a recommended mitigation measure under several of the individual study elements that have been examined in this investigation (e.g., with regard to dune walkovers and the use of water craft pumpout stations). Clearly, a knowledgeable resident population should be considered as an important component of any management plan to minimize the overall impact of the subject communities.

In addition to education efforts that are directed at specific problems (as identified in earlier sections of this report), community residents would benefit from a more comprehensive general understanding of the barrier and bay island environment. Toward that goal, it is recommended that the Town of Babylon, in conjunction with local resident organizations such as the community associations and STBF, continue to support and expand upon such efforts as are discussed in Section 10.4.

10.6.4 MANAGEMENT OF GILGO/WEST GILGO OCEANFRONT

Although it appears likely at the present time that beach nourishment and dune restoration activities along Gilgo and West Gilgo Beaches will be continued indefinitely, there is no guarantee that future conditions will not cause these projects to eventually be abandoned. Furthermore, given the accelerated rate of erosion that has resulted from recent storms, even if these projects are undertaken as planned, their effectiveness is not assured. In the event of the discontinuation of these projects (or the failure of these project to achieve their objectives), resulting in the loss of Ocean Parkway to storm damage, the Gilgo and West Gilgo Beach communities would front directly on the Atlantic Ocean. Under such circumstances, the conclusions and recommendations presented in this report should be re-evaluated in terms of the degree of storm protection afforded the two residential communities at this location, and amended management strategies should be formulated.

10.6.5 MANAGEMENT OF COASTAL EROSION HAZARD AREA

The portion of the study area that is presently most susceptible to storm damage lies within the coastal erosion hazard area (CEHA), which consists of the first row of houses along Oak Beach. As discussed in Section 4.5.1.C, it is expected that the CEHA regulations promulgated by the Town of Babylon will be applied to prohibit the restoration of structures that are substantially damaged during a coastal storm. This management strategy appears to be sound, and is supported by CA. The destruction of houses within the CEHA by storms would confirm that this area is prone to such damage, and the in-place restoration of such houses would not be consistent with prudent environmental planning.

Efforts have been made by some governmental agencies to effect the involuntary removal of CEHA houses for reasons other than storm-induced damage (e.g., fire damage). However, this action would not be tied directly to an established relationship between the structure's presence in the CEHA and its susceptibility to storm damage and, therefore, would not be supported by the findings and conclusions of this study.

FINAL REPORT

APPENDICES

Environmental Study of the Barrier and Bay Island Communities

Town of Babylon, New York

Submitted To:

Town of Babylon
Lindenhurst, New York 11757

Prepared By:

Cashin Associates, P.C.
1200 Veterans Memorial Highway
Hauppauge, New York 11788
(516) 348-7600

JUNE 1994

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APPENDICES

Appendix A	Homeowner's Survey - Discussion, Summary of Results, Questionnaires
Appendix B	Surface Water Quality Data - Suffolk County Department of Health Services, New York State Department of Environmental Conservation
Appendix C	Environmental Assessment of the Babylon Outer Beach Communities, by EEA, Inc., Garden City, New York. January 1991.
	Spartina alterniflora Biomass Study of the Babylon Outer Beach Communities, by EEA, Inc., Garden City, New York. November 1992.
Appendix D	Biological Resources Materials
Appendix E	Materials Used In Development Potential Analysis - Rent Riders for Outer Beach Communities, Suffolk County Tax Maps of Study Area, Index of Lot Designations

APPENDIX A

APPENDIX A

HOMEOWNER SURVEY
DISCUSSION OF RESULTS

The homeowner survey achieved an overall 80 percent rate of response (331 completed surveys were received from the 415 homes in the study area). One community (the Oak Beach Association) had a 100 percent response. Even the lowest response rate of 66 percent for West Gilgo Beach was impressive for this type of investigation.

For the sake of clarity, the analysis presented here is based on simple percentages drawn from the total database compiled for all 331 responses. This approach assumes that variations among the six communities would tend to be balanced overall and, therefore, that a complex, weighted analysis is not necessary. This assumption appears to be valid because the rate of response from each of the three geographic areas of the Outer Beach (i.e., the ocean side of the barrier, represented by the Oak Beach communities; the bay side of the barrier, represented by West Gilgo and Gilgo Beach; and Captree and Oak Islands in the bay) is within 5 percentage points of the overall 80 percent response rate.

The following is a topic-by-topic discussion of the results of the homeowner survey. Refer to the tables at the end of this Appendix for a listing of the accompanying summary data.

A. Occupancy

The average length of time that a family has occupied the houses in the study area is 25 years, while the median residency term is 21 years. These data indicate a very stable, well-established community.

Some of the houses in the study area have been occupied by the respondents' families for close to 100 years, which indicates that these residences have been passed down through the generations since the early days of the Outer Beach communities.

The survey indicates that approximately 54 percent of the homes in the study area are occupied on a year-round basis, while the remaining 46 percent are classified as seasonal occupancy. This compares to data from the 1990 census, which places year-round dwellings at 47 percent of the total housing stock on the Outer Beach, with seasonal homes accounting for the reamining 53 percent (see Section 6.2.1 of the main report).

Fourteen percent of the houses are present used seasonally, but are suitable for year-round use in terms of heating, insulation, utilities, etc. Four percent of the houses are seasonal units that are not presently suitable for winter occupancy, but have specific plans for conversion to year-round use. The remaining 25 percent of the houses surveyed are seasonal and have not been slated for conversion.

B. Location

Slightly over one-half of the homes in the study area have been described by the respondents as having a waterfront location, including all the homes on Captree and Oak Islands. Twenty-eight percent of the houses lack direct vehicular access (e.g., a driveway or curbside parking), including all the homes on Oak Island, which has no land transportation connection to the local roadway system. The residents of 17 percent of the houses in the remaining communities (specifically Oak Beach and West Gilgo Beach) lack vehicular access, and have to walk from a designated parking location to their homes.

C. Demographic statistics

The survey indicates a total of 26 school children in the 331 houses which responded. If it is assumed that this ratio of 0.0785 school children per house is also representative of the 84 houses from which no response was received, the total number of school children in the subject communities can be estimated at 33. Note that the cost-benefit analysis presented in Section 7 of the main text of this report utilized 42 as the number of school children, based on information provided by the Long Island Regional Planning Board.

The survey identified 251 residents over the age of 65 in the 331 houses that responded to a survey. This averages to 0.76 senior citizens per household.

D. Flooding and Storm Information

The information provided in the flooding and storm information questions of the survey pertain only to the respondents' period of residency in their current Outer Beach house. Consequently, the responses are limited to the past 20 to 30 years, for the most part. The storms that are listed in the surveys with regard to evacuation orders/recommendations are almost entirely confined to the past ten years, including Hurricane Gloria (1985), Hurricane Bob (1991), and Tropical Storm Danielle (1992), and recent northeast storms. Therefore, it is possible that these data are not representative of conditions over the longer-term.

Fifty-seven percent of the respondents indicated that they have received at least one official storm evacuation order or recommendation, mostly during Hurricane Gloria in 1985. Overall, 45 percent of the 331 survey houses were actually evacuated (i.e., 79 percent of those who received an order/recommendation). Ten percent of all the houses surveyed received an evacuation order or recommendation but were not actually evacuated (i.e., there was an 18 percent rate of non-compliance with the evacuation orders/recommendations).

Flooding has occurred to 14 percent of the houses surveyed. However, property damage has been sustained by only 10 percent of houses (i.e., property damage did not result in 32 percent of the flooding cases).

Flood insurance policies are in effect for 61 percent of the houses surveyed. This rate of participation in the National Flood Insurance Program (NFIP) is much higher than was expected from previous discussion with agency officials.

Only 8 percent of the houses surveyed have been involved in a flood damage claim through the NFIP (i.e., 14 percent of the houses covered by flood insurance). Nearly all of these claims resulted in the issuance of payment.

E. <u>Drinking Water</u>

The primary sources of drinking water in the study area are private wells (which serve 52 percent of the homes surveyed), bottled water (which is used in 28 percent of the homes), and community wells (which serve 28 percent of the homes). Cisterns and other supplies are of negligible importance for drinking water supplies. These values total to greater than 100 percent because some of the respondents indicated that more than one source of drinking water was used.

As noted in Section 3 of the main text of the report, community wells are subject to regulation by the Suffolk County Department of Health Services (SCDHS), including regular testing. Therefore, it is presumed that these water supplies are safe. However, some concern was initially expressed with respect to the use of private wells, which are not regulated by the County. In particular, the SCDHS indicated that some of the homes on the Outer Beach may be using shallow wells to provide drinking water supplies. These shallow wells draw from a portion of the groundwater aquifer that has been subject to widespread contamination from sources related to human activities on the land surface (e.g., sewage disposal, the application of fertilizer and agricultural chemicals, hazardous materials spills, etc.).

Although the data collected during this survey show that the vast majority of the private drinking water wells in the study area tap into the Magothy or the lower portion of the Upper Glacial aquifer, there appears to be some validity to the SCDHS' concerns about the use of shallow wells for potable water supplies. Almost four percent of the surveys (representing 12 Outer Beach residences of the 331 surveyed) listed private wells with depths of 50 feet or less as their source of drinking water. These results indicate the need to conduct a follow-up investigation of the affected communities (i.e., the Oak Beach Association and Gilgo Beach) to confirm these findings. Since the homeowner survey was conducted anonymously, some effort must be expended to identify the residents who are using shallow wells for potable supplies, including those who did not respond to the survey. If the suspected use of shallow drinking water wells is confirmed, appropriate mitigation measures should be implemented. These measures include a suitable public education program regarding the possible health571Xconsequencesf drinking water from the shallow aquifer and the need to use bottled water for human consumption, and possibly connection to existing deep wells or the installation of new deep wells.

Although the majority (69 percent) of the respondents listed no secondary source of water, some residents in the subject communities utilize sources of water for uses other than human consumption, especially in cases where bottled water is used for drinking. Fourteen percent of the houses surveyed utilize private wells to supply non-potable water, with shallow wells (with a depth of 50 feet or less) being most common. Cisterns and other rainwater collection systems are also an important secondary water supply source, listed on approximately 13 percent of the surveys.

F. Potential Groundwater and Surface Water Impacts

Several survey questions were designed to provide some information regarding the potential groundwater and surface water impacts of the subject communities. Although the use of lawn and landscaping fertilizer can be a source of contamination of the shallow layers of the groundwater aquifer, the survey responses indicate that fertilizer use is very low in the subject communities. Only 16 percent of those surveyed indicated that they use any fertilizer on their properties, and most of these individuals responded that they used natural fertilizer rather than chemical fertilizer.

The use of de-icing salts can elevate the level of chlorides in groundwater. However, this does not appear to be a problem with respect to the residential communities of the Outer Beach. Less than two percent of the survey respondents indicated that they apply salt for pavement de-icing in the winter.

Fecal wastes from pets can be a source of coliform bacteria contamination in stormwater runoff discharged to adjacent surface waters. The surveys indicate an average population of 0.44 pets which spend time out-of-doors in each household. This number does not appear to be unusually high, although the proximity to surface waters increases the likelihood that wastes generated by these animals will reach those water bodies.

G. Recreational Activities

Fifty-three percent of respondents own or lease a motorized boat, while 47 percent do not. Most of these boats are kept at private docks adjacent to the vessel owners' residences.

Fishing is a popular recreational activity among residents of the subject communities, listed on 45 percent of the surveys. Bluefish, snappers, flounder, fluke, striped bass and weakfish are the most common fish varieties caught and kept. Sea robins are also commonly caught, but are generally returned to the water. Less than five percent of the respondents indicated that they hunt waterfowl in Great South Bay.

H. Wildlife and Conservation Activities

Sixty percent of the respondents indicated that they engage in some form of wildlife feeding activity. The most common method of wildlife feeding is birdhouses (47 percent), followed by plantings that provide food (such as berry bushes and corn/grain plants, at 27 percent), feed for mammals (such as corn grain, nuts and hay, at 12 percent). Bread placed out for waterfowl is the primary component of the "other" category of wildlife feeding.

Sixty percent of the respondents also indicated that they engage in conservation efforts. Beach cleanup (49 percent), beach grass planting (27 percent) and sand fence placement (26 percent) are the primary activities listed. Educational programs (13 percent) and the roping of shorebird habitat (7 percent) are also common. The "other" category includes tree planting, the installation of osprey nesting platforms, donations to local environmental groups (especially Save the Beaches Fund), collection of mosquito larvae samples from local marshes, debris cleanup, participation in the placement of Christmas trees along the dunes at Gilgo Beach, and various additional activities.

ENVIRONMENTAL STUDY OF THE BARRIER AND BAY ISLAND COMMUNITIES
TOWN OF BABYLON, NEW YORK
Resident Survey - Summary Results (percentages)

A-		Community:	TOTAL - ALL SIX COMMUNITIES					
		number of houses:	415					
		number of responses:	331		percent response:			80
B-		Years of Occupancy:	Mean:	25.2	Median:	21.3	(in years)	
			0-5:	8.8	21-30:	20.5		
			6-10:	12.4	31+:	27.8		
			11-20:	28.1	N/A:	2.4		
C-	(1)	vehicular access:	YES:	71.3	NO:	27.8	N/A	0.9
	(2)	waterfront location:	YES:	54.7	NO:	40.5	N/A	4.8
D-	(1)	type of occupancy:	yr-rd:	55.6	seas:	44.1	N/A	0.3
	(2)	suitable for yr-round:	YES:	14.8	NO:	29.3	N/A	0.0
	(3)	plans to convert:	YES:	3.9	NO:	24.8	N/A	0.6
E-	(1)	school children:	YES:	4.5	NO:	95.5		
	(2)	# school children:	total:	26				
F-		# residents 65 yrs +:	total:	251	avg/hse:	0.8		
G-		# motor vehicles	total:	497	avg/hse:	1.5		
H-		off-road vehicle use:	YES:	2.4	NO:	97.6		
I-	(1)	storm evacuation order:	YES:	57.1	NO:	42.0	N/A	0.9
	(2)	actual evacuation:	YES:	45.0	NO:	10.0	N/A	2.1
J-	(1)	flooding:	YES:	14.2	NO:	85.8	N/A	0.0
	(2)	property damage:	YES:	9.7	NO:	3.9	N/A	0.6
K-	(1)	flood insurance:	YES:	61.0	NO:	39.0	N/A	0.0
	(2)	flood insurance claim:	YES:	8.5	NO:	51.7	N/A	0.9
	(3)	flood claim payment:	YES:	7.3	NO:	0.9	N/A	0.3
*L-	(1)	drinking water source:	bottled:			28.1		
			pvt well:			51.7		
			cistern:			0.6		
			community well:			23.9		
			other:			0.3		
			N/A:			0.3		
		pvt well depth:	0-50 ft:	3.6				
			51-100 ft:	0.3				
			101-200 ft:	5.1				
			201-300 ft:	16.6				
			301+ ft:	21.1				
			N/A:	4.8				

ENVIRONMENTAL STUDY OF THE BARRIER AND BAY ISLAND COMMUNITIES
TOWN OF BABYLON, NEW YORK
Resident Survey - Summary Results (percentages)
page 2 of 2 for TOTAL - ALL SIX COMMUNITIES

* (2)	other water supply:	none:	68.9				
		pvt well:	13.6				
		cistern:	10.9				
		community well:	1.8				
		other:	1.8				
	pvt well depth:	0-50 ft:	5.7				
		51-100 ft:	0.0				
		101-200 ft:	0.9				
		201-300 ft:	1.5				
		301+ ft:	2.1				
		N/A:	3.3				
M- (1)	fertilizer use:	YES:	15.7	NO:	84.0	N/A	0.3
(2)	fertilizer type:	natural	8.5	chem:	1.5		
		both:	4.8	N/A:	0.9		
(3)	de-icing salt use:	YES:	1.5	NO:	91.8	N/A:	6.6
N- (1)	outdoor pets:	YES:	30.5	NO:	69.5		
(2)	number of each type:	cats:	0.18	dogs:	0.25	\ average #	
		other:	0.01			/ per house	
O-	motorized boats	YES:	52.6	NO:	46.5	N/A:	0.9
P- (1)	fish in Town waters:	YES:	45.3	NO:	54.1	N/A:	0.6
Q-	hunt waterfowl:	YES:	4.5	NO:	94.6	N/A:	0.9
R- (1)	feed wildlife:	YES:	59.5	NO:	40.5		
* (2)	type of feeding:	bird feeders:	47.4				
		plantings:	27.2				
		feed for mammals:	12.1				
		other:	5.1				
S- (1)	conservation activities:	YES:	59.8	NO:	40.2		
* (2)		beach grass planting:	27.5				
		sand fence placement:	26.0				
		shorebird habitat roping:	6.9				
		beach cleanup:	48.9				
		educational programs:	12.7				
		other:	11.2				

NOTES: Unless otherwise noted, all values are the PERCENTAGE of surveys giving a particular response.
N/A indicates the number of surveys on which NO ANSWER was given.
A "*" indicates that more than one response was acceptable on each survey. Therefore, the sum of the responses is greater than 100%.

ENVIRONMENTAL STUDY OF THE BARRIER AND BAY ISLAND COMMUNITIES
TOWN OF BABYLON, NEW YORK
Resident Survey - Summary Results

A-		Community:	West Gilgo Beach					
		number of houses:	80					
		number of responses:	53					
B-		Years of Occupancy:	Mean:	26.1	Median:	24.0		
			0-5:	4	21-30:	10		
			6-10:	9	31+:	19		
			11-20:	11	N/A:	0		
C-	(1)	vehicular access:	YES:	29	NO:	23	N/A:	1
	(2)	waterfront location:	YES:	8	NO:	42	N/A:	3
D-	(1)	type of occupancy:	yr-rd:	22	seas:	31	N/A:	0
	(2)	suitable for yr-round:	YES:	8	NO:	23	N/A:	0
	(3)	plans to convert:	YES:	2	NO:	21	N/A:	0
E-	(1)	school children:	YES:	3	NO:	50		
	(2)	# school children:	total:	5				
F-		# residents 65 yrs +:	total:	31				
G-		# motor vehicles	total:	86	avg/hse:	1.6		
H-		off-road vehicle use:	YES:	1	NO:	52		
I-	(1)	storm evacuation order:	YES:	33	NO:	20	N/A:	0
	(2)	actual evacuation:	YES:	20	NO:	11	N/A:	2
J-	(1)	flooding:	YES:	3	NO:	50	N/A:	0
	(2)	property damage:	YES:	1	NO:	1	N/A:	1
K-	(1)	flood insurance:	YES:	36	NO:	17	N/A:	0
	(2)	flood insurance claim:	YES:	1	NO:	33	N/A:	2
	(3)	flood claim payment:	YES:	1	NO:	0	N/A:	0
*L-	(1)	drinking water source:	bottled:			4		
			pvt well:			0		
			cistern:			0		
			community well:			52		
			other:			0		
			N/A:			0		
		pvt well depth:	0-50 ft:		0			
			51-100 ft:		0			
			101-200 ft:		0			
			201-300 ft:		0			
			301+ ft:		0			
			N/A:		0			

ENVIRONMENTAL STUDY OF THE BARRIER AND BAY ISLAND COMMUNITIES
TOWN OF BABYLON, NEW YORK
Resident Survey - Summary Results
page 2 of 2 for West Gilgo Beach

*	(2)	other water supply:	none:			43			
			pvt well:			8			
			cistern:			0			
			community well:			0			
			other:			0			
		pvt well depth:	0-50 ft:		3				
			51-100 ft:		0				
			101-200 ft:		1				
			201-300 ft:		1				
			301+ ft:		2				
			N/A:		1				
M-	(1)	fertilizer use:	YES:	8	NO:	45		N/A:	0
	(2)	fertilizer type:	natural	2	chem:	1			
			both:	5	N/A:	0			
	(3)	de-icing salt use:	YES:	2	NO:	45		N/A:	6
N-	(1)	outdoor pets:	YES:	16	NO:	37			
	(2)	number of each type:	cats:	6	dogs:	15			
			other:	1	N/A:	0			
O-		motorized boats	YES:	24	NO:	29		N/A:	0
P-	(1)	fish in Town waters:	YES:	26	NO:	27		N/A:	0
Q-		hunt waterfowl:	YES:	0	NO:	53		N/A:	0
R-	(1)	feed wildlife:	YES:	21	NO:	32			
*	(2)	type of feeding:	bird feeders:			20			
			plantings:			6			
			feed for mammals:			6			
			other:			1			
S-	(1)	conservation activities:	YES:	39	NO:	14			
*	(2)		beach grass planting:				7		
			sand fence placement:				6		
			shorebird habitat roping:				2		
			beach cleanup:				38		
			educational programs:				8		
			other:				7		

NOTES: Unless otherwise noted, all values are the number of surveys giving a particular response.
N/A indicates the number of surveys on which NO ANSWER was given.
A "*" indicates that more than one response was acceptable on each survey. Therefore, the sum of the responses is greater than the number of surveys.

ENVIRONMENTAL STUDY OF THE BARRIER AND BAY ISLAND COMMUNITIES
TOWN OF BABYLON, NEW YORK
Resident Survey - Summary Results

A- Community: Gilgo Beach
number of houses: 57
number of responses: 51

B-		Years of Occupancy:	Mean:	19.9	Median:	20.5		
			0-5:	8	21-30:	13		
			6-10:	7	31+:	12		
			11-20:	10	N/A:	1		
C-	(1)	vehicular access:	YES:	51	NO:	0	N/A:	0
	(2)	waterfront location:	YES:	23	NO:	25	N/A:	3
D-	(1)	type of occupancy:	yr-rd:	26	seas:	25	N/A:	0
	(2)	suitable for yr-round:	YES:	13	NO:	12	N/A:	0
	(3)	plans to convert:	YES:	7	NO:	5	N/A:	0
E-	(1)	school children:	YES:	1	NO:	50		
	(2)	# school children:	total:	2				
F-		# residents 65 yrs +:	total:	29				
G-		# motor vehicles	total:	95	avg/hse:	1.9		
H-		off-road vehicle use:	YES:	2	NO:	49		
I-	(1)	storm evacuation order:	YES:	21	NO:	30	N/A:	0
	(2)	actual evacuation:	YES:	14	NO:	7	N/A:	0
J-	(1)	flooding:	YES:	4	NO:	47	N/A:	0
	(2)	property damage:	YES:	3	NO:	1	N/A:	0
K-	(1)	flood insurance:	YES:	42	NO:	9	N/A:	0
	(2)	flood insurance claim:	YES:	2	NO:	40	N/A:	0
	(3)	flood claim payment:	YES:	0	NO:	1	N/A:	1

*L-	(1)	drinking water source:	bottled:		15
			pvt well:		39
			cistern:		0
			community well:		0
			other:		0
			N/A:		1
		pvt well depth:	0-50 ft:	5	
			51-100 ft:	0	
			101-200 ft:	0	
			201-300 ft:	6	
			301+ ft:	24	
			N/A:	4	

ENVIRONMENTAL STUDY OF THE BARRIER AND BAY ISLAND COMMUNITIES
TOWN OF BABYLON, NEW YORK
Resident Survey - Summary Results

*	(2)	other water supply:	none:			35			
			pvt well:			10			
			cistern:			1			
			community well:			0			
			other:			1			
		pvt well depth:	0-50 ft:		4				
			51-100 ft:		0				
			101-200 ft:		2				
			201-300 ft:		0				
			301+ ft:		1				
			N/A:		3				
M-	(1)	fertilizer use:	YES:	8	NO:	43	N/A:	0	
	(2)	fertilizer type:	natural	3	chem:	1			
			both:	2	N/A:	2			
	(3)	de-icing salt use:	YES:	0	NO:	51	N/A:	0	
N-	(1)	outdoor pets:	YES:	12	NO:	39			
	(2)	number of each type:	cats:	2	dogs:	12			
			other:	0	N/A:	0			
O-		motorized boats	YES:	14	NO:	36	N/A:	1	
P-	(1)	fish in Town waters:	YES:	18	NO:	33	N/A:	0	
Q-		hunt waterfowl:	YES:	2	NO:	49	N/A:	0	
R-	(1)	feed wildlife:	YES:	28	NO:	23			
*	(2)	type of feeding:	bird feeders:			24			
			plantings:			18			
			feed for mammals:			5			
			other:			0			
S-	(1)	conservation activities:	YES:	24	NO:	27			
*	(2)		beach grass planting:						9
			sand fence placement:						6
			shorebird habitat roping:						8
			beach cleanup:						13
			educational programs:						11
			other:						7

NOTES: Unless otherwise noted, all values are the number of surveys giving a particular response.
N/A indicates the number of surveys on which NO ANSWER was given.
A "*" indicates that more than one response was acceptable on each survey. Therefore, the sum of the responses is greater than the number of surveys.

ENVIRONMENTAL STUDY OF THE BARRIER AND BAY ISLAND COMMUNITIES
TOWN OF BABYLON, NEW YORK
Resident Survey - Summary Results

A-		Community:	Oak Island					
		number of houses:	54					
		number of responses:	46					
B-		Years of Occupancy:	Mean:	31.6	Median:	23.0	(in years)	
			0-5:	3	21-30:	11		
			6-10:	5	31+:	15		
			11-20:	9	N/A:	3		
C-	(1)	vehicular access:	YES:	0	NO:	46	N/A:	0
	(2)	waterfront location:	YES:	46	NO:	0	N/A:	0
D-	(1)	type of occupancy:	yr-rd:	0	seas:	46	N/A:	0
	(2)	suitable for yr-round:	YES:	4	NO:	42	N/A:	0
	(3)	plans to convert:	YES:	0	NO:	40	N/A:	2
E-	(1)	school children:	YES:	0	NO:	46		
	(2)	# school children:	total:	0				
F-		# residents 65 yrs +:	total:	42				
G-		# motor vehicles	total:	0	avg/hse:	0.0		
H-		off-road vehicle use:	YES:	0	NO:	46		
I-	(1)	storm evacuation order:	YES:	7	NO:	39	N/A:	0
	(2)	actual evacuation:	YES:	5	NO:	2	N/A:	0
J-	(1)	flooding:	YES:	3	NO:	43	N/A:	0
	(2)	property damage:	YES:	2	NO:	1	N/A:	0
K-	(1)	flood insurance:	YES:	10	NO:	36	N/A:	0
	(2)	flood insurance claim:	YES:	1	NO:	9	N/A:	0
	(3)	flood claim payment:	YES:	1	NO:	0	N/A:	0
L-	(1)	drinking water source:	bottled:			44		
			pvt well:			0		
			cistern:			2		
			community well:			0		
			other:			0		
			N/A:			0		
		pvt well depth:	0-50 ft:		0			
			51-100 ft:		0			
			101-200 ft:		0			
			201-300 ft:		0			
			301+ ft:		0			
			N/A:		0			

ENVIRONMENTAL STUDY OF THE BARRIER AND BAY ISLAND COMMUNITIES
TOWN OF BABYLON, NEW YORK
Resident Survey - Summary Results
page 2 of 2 for Oak Island

*	(2)	other water supply:	none:			3		
			pvt well:			6		
			cistern:			34		
			community well:			0		
			other:			0		
		pvt well depth:	0-50 ft:			5		
			51-100 ft:			0		
			101-200 ft:			0		
			201-300 ft:			0		
			301+ ft:			0		
			N/A:			1		
M-	(1)	fertilizer use:	YES:	3	NO:	43	N/A:	0
	(2)	fertilizer type:	natural	2	chem:	0		
			both:	1	N/A:	0		
	(3)	de-icing salt use:	YES:	0	NO:	43	N/A:	3
N-	(1)	outdoor pets:	YES:	12	NO:	34		
	(2)	number of each type:	cats:	4	dogs:	10		
			other:	0	N/A:	0		
O-		motorized boats	YES:	42	NO:	4	N/A:	0
P-	(1)	fish in Town waters:	YES:	26	NO:	20	N/A:	0
Q-		hunt waterfowl:	YES:	2	NO:	43	N/A:	1
R-	(1)	feed wildlife:	YES:	30	NO:	16		
*	(2)	type of feeding:	bird feeders:			19		
			plantings:			9		
			feed for mammals:			4		
			other:			10		
S-	(1)	conservation activities:	YES:	25	NO:	21		
*	(2)		beach grass planting:					4
			sand fence placement:					1
			shorebird habitat roping:					1
			beach cleanup:					20
			educational programs:					3
			other:					5

NOTES: Unless otherwise noted, all values are the number of surveys giving a particular response.
N/A indicates the number of surveys on which NO ANSWER was given.
A "*" indicates that more than one response was acceptable on each survey. Therefore, the sum of the responses is greater than the number of surveys.

ENVIRONMENTAL STUDY OF THE BARRIER AND BAY ISLAND COMMUNITIES
TOWN OF BABYLON, NEW YORK
Resident Survey - Summary Results

A-		Community:	Captree Island					
		number of houses:	32					
		number of responses:	23					
B-		Years of Occupancy:	Mean:	28.1	Median:	27.0		
			0-5:	1	21-30:	4		
			6-10:	1	31+:	10		
			11-20:	7	N/A:	0		
C-	(1)	vehicular access:	YES:	23	NO:	0	N/A:	0
	(2)	waterfront location:	YES:	23	NO:	0	N/A:	0
D-	(1)	type of occupancy:	yr-rd:	17	seas:	6	N/A:	0
	(2)	suitable for yr-round:	YES:	2	NO:	4	N/A:	0
	(3)	plans to convert:	YES:	1	NO:	3	N/A:	0
E-	(1)	school children:	YES:	2	NO:	21		
	(2)	# school children:	total:	5				
F-		# residents 65 yrs +:	total:	21				
G-		# motor vehicles	total:	46	avg/hse:	2.0		
H-		off-road vehicle use:	YES:	0	NO:	23		
I-	(1)	storm evacuation order:	YES:	16	NO:	7	N/A:	0
	(2)	actual evacuation:	YES:	12	NO:	3	N/A:	1
J-	(1)	flooding:	YES:	4	NO:	19	N/A:	0
	(2)	property damage:	YES:	3	NO:	1	N/A:	0
K-	(1)	flood insurance:	YES:	14	NO:	9	N/A:	0
	(2)	flood insurance claim:	YES:	7	NO:	7	N/A:	0
	(3)	flood claim payment:	YES:	6	NO:	1	N/A:	0
*L-	(1)	drinking water source:	bottled:			7		
			pvt well:			19		
			cistern:			0		
			community well:			0		
			other:			0		
			N/A:			0		
		pvt well depth:	0-50 ft:		0			
			51-100 ft:		0			
			101-200 ft:		1			
			201-300 ft:		14			
			301+ ft:		0			
			N/A:		4			

ENVIRONMENTAL STUDY OF THE BARRIER AND BAY ISLAND COMMUNITIES
TOWN OF BABYLON, NEW YORK
Resident Survey - Summary Results
page 2 of 2 for Captree Island

*	(2) other water supply:	none:				18		
		pvt well:				4		
		cistern:				0		
		community well:				0		
		other:				2		
	pvt well depth:	0-50 ft:			0			
		51-100 ft:			0			
		101-200 ft:			0			
		201-300 ft:			4			
		301+ ft:			0			
		N/A:			0			
M-	(1) fertilizer use:	YES:	4	NO:		19	N/A:	0
	(2) fertilizer type:	natural	2	chem:		2		
		both:	0	N/A:		0		
	(3) de-icing salt use:	YES:	0	NO:		23	N/A:	0
N-	(1) outdoor pets:	YES:	9	NO:		14		
	(2) number of each type:	cats:	18	dogs:		3		
		other:	0	N/A:		0		
O-	motorized boats	YES:	14	NO:		9	N/A:	0
P-	(1) fish in Town waters:	YES:	10	NO:		12	N/A:	1
Q-	hunt waterfowl:	YES:	6	NO:		17	N/A:	0
R-	(1) feed wildlife:	YES:	19	NO:		4		
*	(2) type of feeding:	bird feeders:				17		
		plantings:				8		
		feed for mammals:				4		
		other:				2		
S-	(1) conservation activities:	YES:	14	NO:		9		
*	(2)	beach grass planting:					7	
		sand fence placement:					4	
		shorebird habitat roping:					0	
		beach cleanup:					9	
		educational programs:					4	
		other:					5	

NOTES: Unless otherwise noted, all values are the number of surveys giving a particular response.
N/A indicates the number of surveys on which NO ANSWER was given.
A "*" indicates that more than one response was acceptable on each survey. Therefore, the sum of the responses is greater than the number of surveys.

ENVIRONMENTAL STUDY OF THE BARRIER AND BAY ISLAND COMMUNITIES
TOWN OF BABYLON, NEW YORK
Resident Survey - Summary Results

A-	Community: Oak Beach (unassociated)						
	number of houses: 120						
	number of responses: 86						
B-	Years of Occupancy:	Mean:	26.0	Median:	20.0		
		0-5:	7	21-30:	14		
		6-10:	11	31+:	24		
		11-20:	27	N/A:	3		
C-	(1) vehicular access:	YES:	65	NO:	19	N/A:	2
	(2) waterfront location:	YES:	51	NO:	33	N/A:	2
D-	(1) type of occupancy:	yr-rd:	60	seas:	25	N/A:	1
	(2) suitable for yr-round:	YES:	13	NO:	12	N/A:	0
	(3) plans to convert:	YES:	1	NO:	11	N/A:	0
E-	(1) school children:	YES:	6	NO:	80		
	(2) # school children:	total:	10				
F-	# residents 65 yrs +:	total:	66				
G-	# motor vehicles	total:	146	avg/hse:	1.7		
H-	off-road vehicle use:	YES:	4	NO:	82		
I-	(1) storm evacuation order:	YES:	61	NO:	23	N/A:	2
	(2) actual evacuation:	YES:	52	NO:	6	N/A:	3
J-	(1) flooding:	YES:	27	NO:	59	N/A:	0
	(2) property damage:	YES:	19	NO:	7	N/A:	1
K-	(1) flood insurance:	YES:	47	NO:	39	N/A:	0
	(2) flood insurance claim:	YES:	13	NO:	33	N/A:	1
	(3) flood claim payment:	YES:	12	NO:	1	N/A:	0
*L-	(1) drinking water source:	bottled:			10		
		pvt well:			47		
		cistern:			0		
		community well:			27		
		other:			1		
		N/A:			0		
	pvt well depth:	0-50 ft:		0			
		51-100 ft:		1			
		101-200 ft:		13			
		201-300 ft:		21			
		301+ ft:		7			
		N/A:		5			

ENVIRONMENTAL STUDY OF THE BARRIER AND BAY ISLAND COMMUNITIES
TOWN OF BABYLON, NEW YORK
Resident Survey - Summary Results
page 2 of 2 for Oak Beach (unassociated)

*	(2)	other water supply:	none:	68				
			pvt well:	8				
			cistern:	1				
			community well:	5				
			other:	2				
		pvt well depth:	0-50 ft:	3				
			51-100 ft:	0				
			101-200 ft:	0				
			201-300 ft:	0				
			301+ ft:	1				
			N/A:	4				
M-	(1)	fertilizer use:	YES:	12	NO:	73	N/A:	1
	(2)	fertilizer type:	natural	6	chem:	0		
			both:	6	N/A:	0		
	(3)	de-icing salt use:	YES:	2	NO:	77	N/A:	7
N-	(1)	outdoor pets:	YES:	27	NO:	59		
	(2)	number of each type:	cats:	17	dogs:	21		
			other:	1	N/A:	0		
O-		motorized boats	YES:	47	NO:	38	N/A:	1
P-	(1)	fish in Town waters:	YES:	43	NO:	43	N/A:	0
Q-		hunt waterfowl:	YES:	3	NO:	83	N/A:	0
R-	(1)	feed wildlife:	YES:	50	NO:	36		
*	(2)	type of feeding:	bird feeders:	39				
			plantings:	24				
			feed for mammals:	10				
			other:	1				
S-	(1)	conservation activities:	YES:	42	NO:	44		
*	(2)		beach grass planting:	22				
			sand fence placement:	24				
			shorebird habitat roping:	2				
			beach cleanup:	32				
			educational programs:	12				
			other:	5				

NOTES: Unless otherwise noted, all values are the number of surveys giving a particular response.
N/A indicates the number of surveys on which NO ANSWER was given.
A "*" indicates that more than one response was acceptable on each survey. Therefore, the sum of the responses is greater than the number of surveys.

ENVIRONMENTAL STUDY OF THE BARRIER AND BAY ISLAND COMMUNITIES
TOWN OF BABYLON, NEW YORK
Resident Survey - Summary Results

A-		Community:	Oak Beach Association					
		number of houses:	72					
		number of responses:	72					
B-		Years of Occupancy:	Mean:	22.2	Median:	18.5		
			0-5:	6	21-30:	16		
			6-10:	8	31+:	12		
			11-20:	29	N/A:	1		
C-	(1)	vehicular access:	YES:	68	NO:	4	N/A:	0
	(2)	waterfront location:	YES:	30	NO:	34	N/A:	8
D-	(1)	type of occupancy:	yr-rd:	59	seas:	13	N/A:	0
	(2)	suitable for yr-round:	YES:	9	NO:	4	N/A:	0
	(3)	plans to convert:	YES:	2	NO:	2	N/A:	0
E-	(1)	school children:	YES:	3	NO:	69		
	(2)	# school children:	total:	4				
F-		# residents 65 yrs +:	total:	62				
G-		# motor vehicles	total:	124	avg/hse:	1.7		
H-		off-road vehicle use:	YES:	1	NO:	71		
I-	(1)	storm evacuation order:	YES:	51	NO:	20	N/A:	1
	(2)	actual evacuation:	YES:	46	NO:	4	N/A:	1
J-	(1)	flooding:	YES:	6	NO:	66	N/A:	0
	(2)	property damage:	YES:	4	NO:	2	N/A:	0
K-	(1)	flood insurance:	YES:	53	NO:	19	N/A:	0
	(2)	flood insurance claim:	YES:	4	NO:	49	N/A:	0
	(3)	flood claim payment:	YES:	4	NO:	0	N/A:	0
*L-	(1)	drinking water source:	bottled:			13		
			pvt well:			66		
			cistern:			0		
			community well:			0		
			other:			0		
			N/A:			0		
		pvt well depth:	0-50 ft:		7			
			51-100 ft:		0			
			101-200 ft:		3			
			201-300 ft:		14			
			301+ ft:		39			
			N/A:		3			

ENVIRONMENTAL STUDY OF THE BARRIER AND BAY ISLAND COMMUNITIES
TOWN OF BABYLON, NEW YORK
Resident Survey - Summary Results
page 2 of 2 for Oak Beach Association

	(2)	other water supply:	none:			61		
			pvt well:			9		
			cistern:			0		
			community well:			1		
			other:			1		
		pvt well depth:	0-50 ft:		4			
			51-100 ft:		0			
			101-200 ft:		0			
			201-300 ft:		0			
			301+ ft:		3			
			N/A:		2			
M-	(1)	fertilizer use:	YES:	17	NO:	55	N/A:	0
	(2)	fertilizer type:	natural	13	chem:	1		
			both:	2	N/A:	1		
	(3)	de-icing salt use:	YES:	1	NO:	65	N/A:	6
N-	(1)	outdoor pets:	YES:	25	NO:	47		
	(2)	types:	cats:	13	dogs:	22		
			other:	0	N/A:	2		
O-		motorized boats	YES:	33	NO:	38	N/A:	1
P-	(1)	fish in Town waters:	YES:	27	NO:	44	N/A:	1
Q-		hunt waterfowl:	YES:	2	NO:	68	N/A:	2
R-	(1)	feed wildlife:	YES:	49	NO:	23		
*	(2)	type of feeding:	bird feeders:			38		
			plantings:			25		
			feed for mammals:			11		
			other:			3		
S-	(1)	conservation activities:	YES:	54	NO:	18		
*	(2)		beach grass planting:				42	
			sand fence placement:				45	
			shorebird habitat roping:				10	
			beach cleanup:				50	
			educational programs:				4	
			other:				8	

NOTES: Unless otherwise noted, all values are the number of surveys giving a particular response.
N/A indicates the number of surveys on which NO ANSWER was given.
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ENVIRONMENTAL STUDY OF THE BARRIER AND BAY ISLAND COMMUNITIES
TOWN OF BABYLON, NEW YORK
Resident Survey - Summary Results

A-		Community:	TOTAL - ALL SIX COMMUNITIES					
		number of houses:	415					
		number of responses:	331		percent response:			80
B-		Years of Occupancy:	Mean:	25.1	Median:	21.2	(in years)	
			0-5:	29	21-30:	68		
			6-10:	41	31+:	92		
			11-20:	93	N/A:	8		
C-	(1)	vehicular access:	YES:	236	NO:	92	N/A:	3
	(2)	waterfront location:	YES:	181	NO:	134	N/A:	16
D-	(1)	type of occupancy:	yr-rd:	184	seas:	146	N/A:	1
	(2)	suitable for yr-round:	YES:	49	NO:	97	N/A:	0
	(3)	plans to convert:	YES:	13	NO:	82	N/A:	2
E-	(1)	school children:	YES:	15	NO:	316		
	(2)	# school children:	total:	26				
F-		# residents 65 yrs +:	total:	251	avg/hse:	0.8		
G-		# motor vehicles	total:	497	avg/hse:	1.5		
H-		off-road vehicle use:	YES:	8	NO:	323		
I-	(1)	storm evacuation order:	YES:	189	NO:	139	N/A:	3
	(2)	actual evacuation:	YES:	149	NO:	33	N/A:	7
J-	(1)	flooding:	YES:	47	NO:	284	N/A:	0
	(2)	property damage:	YES:	32	NO:	13	N/A:	2
K-	(1)	flood insurance:	YES:	202	NO:	129	N/A:	0
	(2)	flood insurance claim:	YES:	28	NO:	171	N/A:	3
	(3)	flood claim payment:	YES:	24	NO:	3	N/A:	1
*L-	(1)	drinking water source:	bottled:			93		
			pvt well:			171		
			cistern:			2		
			community well:			79		
			other:			1		
			N/A:			1		
		pvt well depth:	0-50 ft:		12			
			51-100 ft:		1			
			101-200 ft:		17			
			201-300 ft:		55			
			301+ ft:		70			
			N/A:		16			

ENVIRONMENTAL STUDY OF THE BARRIER AND BAY ISLAND COMMUNITIES
TOWN OF BABYLON, NEW YORK
Resident Survey - Summary Results

*	(2)	other water supply:	none:			228			
			pvt well:			45			
			cistern:			36			
			community well:			6			
			other:			6			
		pvt well depth:	0-50 ft:		19				
			51-100 ft:		0				
			101-200 ft:		3				
			201-300 ft:		5				
			301+ ft:		7				
			N/A:		11				
M-	(1)	fertilizer use:	YES:	52	NO:	278	N/A:	1	
	(2)	fertilizer type:	natural	28	chem:	5			
			both:	16	N/A:	3			
	(3)	de-icing salt use:	YES:	5	NO:	304	N/A:	22	
N-	(1)	outdoor pets:	YES:	101	NO:	230			
	(2)	number of each type:	cats:	60	dogs:	83			
			other:	2	N/A:	2			
O-		motorized boats	YES:	174	NO:	154	N/A:	3	
P-	(1)	fish in Town waters:	YES:	150	NO:	179	N/A:	2	
Q-		hunt waterfowl:	YES:	15	NO:	313	N/A:	3	
R-	(1)	feed wildlife:	YES:	197	NO:	134			
*	(2)	type of feeding:	bird feeders:			157			
			plantings:			90			
			feed for mammals:			40			
			other:			17			
S-	(1)	conservation activities:	YES:	198	NO:	133			
*	(2)		beach grass planting:				91		
			sand fence placement:				86		
			shorebird habitat roping:				23		
			beach cleanup:				162		
			educational programs:				42		
			other:				37		

NOTES: Unless otherwise noted, all values are the number of surveys giving a particular response.
N/A indicates the number of surveys on which NO ANSWER was given.
A "*" indicates that more than one response was acceptable on each survey. Therefore, the sum of the responses is greater than the number of surveys.

BABYLON BARRIER BEACH
AD HOC COMMITTEE

Box H 12, Oak Beach, New York 11702

Mailed 12/12
Received 12/16
Returned 12/17
No inside envelope

December 1, 1992

Dear Neighbor,

Enclosed you will find a "Resident Survey" for your review and completion. I am sure that you all recall that as part of the settlement of the lawsuit, the Barrier Beach Communities contributed $50,000 toward an Environmental Study. This survey is an important part of the study and your careful and accurate completion of it is necessary for a detailed, fair and beneficial Environmental Study of our area.

In an effort to insure anonymity, we have enclosed two envelopes. Please place your completed survey in the plain envelope, seal it and place this in the stamped, addressed envelope and mail it back to the Ad Hoc Committee as soon as possible. The committee will consolidate the returned surveys and deliver them to the consultant conducting the Environmental Study. Again, this survey is completely anonymous. There is no name, address or any other identifying information on these forms.

We are hoping to have this entire study completed by early 1993, so your prompt completion and return of the survey will be greatly appreciated.

Sincerely,

BABYLON BARRIER BEACH
AD HOC COMMITTEE

Captree Island
Gilgo Beach
W. Gilgo Beach Association
Oak Beach
Oak Beach Association

ENVIRONMENTAL STUDY OF THE BARRIER AND BAY ISLAND COMMUNITIES
TOWN OF BABYLON, NEW YORK
Resident Survey

Directions: This survey is being conducted as part of the Environmental Study of the Barrier and Bay Island Communities of the Town of Babylon. This survey will provide important information that would not otherwise be available to the authors of the study. Please answer all questions as accurately as you can. All answers should pertain strictly to your outer beach residence.

A- Name of community in which your house is located (circle one):
a> West Gilgo Beach *b> Gilgo Beach* *c> Oak Beach (unassociated)*
d> Oak Island *e> Captree Island* *f> Oak Beach Association*

B- How long have you or your family lived at this address? ______ years

C- (1) Does your house have direct vehicular (automobile) access? *yes* *no*
(2) Does your house have a waterfront location? *yes* *no*

D- (1) What is the present occupancy of your house? (circle one)
a> year-round *b> seasonal*
(2) If presently used seasonally, is your house suitable for year-round use (i.e., in terms of heating, insulation, utilities, etc.)? *yes* *no*
(3) If no, do you have specific plans to convert your house to year-round use in the future? *yes* *no*

E- (1) Do any residents of this house attend local public schools (grades K through 12)? *yes* *no*
(2) If yes, indicate: ***a> # children:*** _____ ***b> grades:***____________________

F- Number of residents of this house who are 65 years or older: ______

G- Number of registered motor vehicles used at this house (including cars, trucks, minivans, etc. - but not including boats, trailers, unregistered all-terrain vehicles, etc.)? ______

H- Do you operate off-road vehicles on Town of Babylon beaches? *yes* *no*

I- (1) During your residency in this house, have you ever been asked to evacuate because of a storm? *yes* *no*
(2) If yes, did you actually leave? *yes* *no*
(3) Indicate name of storm(s) or date(s):
a> asked to evacuate:____
b> actually left:____

J- (1) Has your house ever been flooded during your residency here? *yes* *no*
(2) If yes, has any property damage occurred due to flooding? *yes* *no*
(3) If yes, indicate name of storm(s) or date(s), and describe extent of damage: ____
____
____

K- (1) Is this house presently covered by flood insurance? *yes* *no*
(2) If yes, has a flood insurance claim ever been filed? *yes* *no*
(3) If yes, was payment issued for claim? *yes* *no*

L- (1) What is the source of drinking water for this house? (circle one)
a> *bottled water* b> *private well (approx. depth = ________ feet)*
c> *cistern* d> *community well* e> *other* ________________

(2) Other source(s) of water supply for this house (circle one or more)
a> *none* b> *private well (approx. depth = ________ feet)*
c> *cistern* d> *community well* e> *other* ________________

NOTE: an individual well is defined as one which serves 4 or fewer residences; a community well is defined as one which serves 5 or more residences

M- (1) Do you use fertilizer on your property? *yes* *no*
(2) If yes, circle type used: a> *natural* b> *chemical* c> *both*
(3) Do you apply salt for pavement de-icing in the winter? *yes* *no*

N- (1) Do you own any pets which spend time out of doors? *yes* *no*
(2) If yes, indicate the number of each:
a> *cats* _____ b> *dogs* _____
c> *other (indicate type and number)* ________________

O- (1) Do you own or lease a motorized boat(s)? *yes* *no*
(2) If yes, indicate:
a> *type(s):* ________________
b> *length(s):* ________ *feet* c> *motor size(s):* ________ *horsepower*
d> *mooring/docking location(s):* ________________

P- (1) Do you fish in the Town of Babylon's coastal waters (i.e., Great South Bay, Fire Island Inlet, or surfcasting in the Atlantic Ocean)? *yes* *no*

(2) If yes, indicate types of fish caught and released in the last 2 years:
____

(3) indicate types of fish caught and kept in the last 2 years: ________________

Q- (1) Do you hunt waterfowl in Great South Bay? *yes* *no*

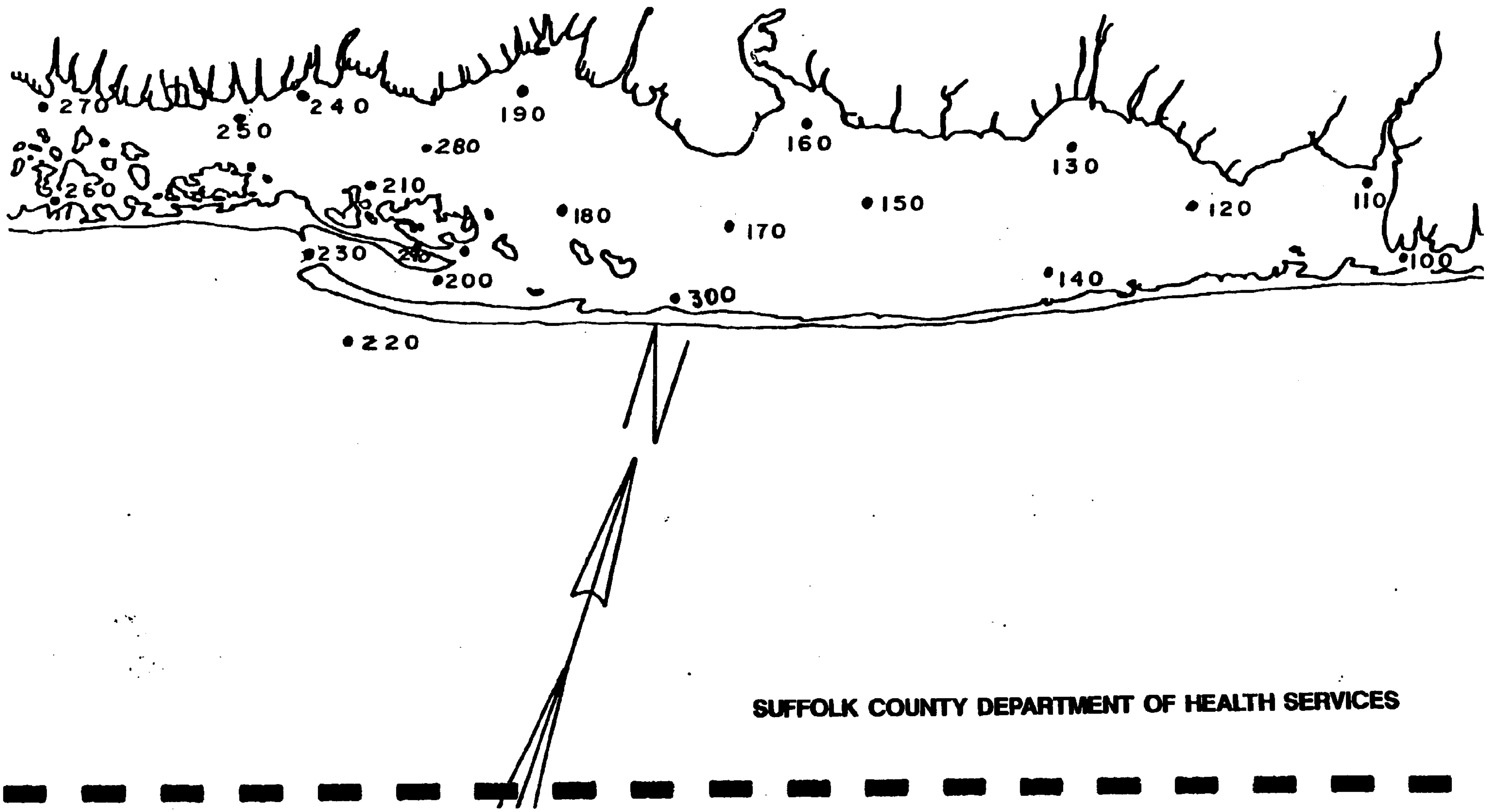
R- (1) Do you feed wildlife on your property? *yes* *no*
(2) If yes, circle the method(s) that apply:
a> *bird feeders*
b> *plantings that provide food (e.g., berry bushes, corn/grain plants)*
c> *placing out food for mammals (e.g., corn, grain, nuts, hay, etc.)*
d> *other (indicate method)* ________________

S- (1) Have you participated in any organized conservation activities on the Babylon barrier and/or bay islands? *yes* *no*
(2) If yes, circle the type of conservation activities that apply and indicate location of project(s):
a> *beach grass planting* ________________
b> *sand fence placement* ________________
c> *string fencing of shorebird habitats* ________________
d> *beach cleanup* ________________
e> *educational programs* ________________
d> *other (indicate type and location)* ________________

APPENDIX B

GREAT SOUTH BAY

STATION MAP (090)



SUFFOLK COUNTY DEPARTMENT OF HEALTH SERVICES

Table B-1

Summary of Suffolk County Department of Health Services Coliform Data
for Samples Collected March 1977 through March 1987

Station	TOTAL COLIFORMS (MPN/100 ML) # Samples (1)	Median Value (2)	# > 330 (3)	% > 330 (4)	FECAL COLIFORMS (MPN/100 ML) # Samples (1)	Median Value (2)	# > 49 (3)	% > 49 (4)
210	42	23	3	7.1	42	10	2	4.8
230	33	<10	0	0	32	<10	0	0
250	39	23	3	7.7	39	<10	3	7.7
260	39	<10	2	5.1	40	<10	2	5.0
280	27	23	1	3.7	28	<10	1	3.6
290	28	<30	2	7.1	27	<10	1	3.7

NOTES

(1) number of samples collected and analyzed
(2) median value of samples analyzed
(3) number of samples exceeding specified value (see NYSDEC criteria, below)
(4) percent of samples exceeding specified value

- full data listing is also included in this Appendix (see Table __)
- see map for station locations: Stations 230, 260, and 290 are in the vicinity of the Town of Babylon barrier and bay island communities; Stations 210, 250, and 280 are located in the main portion of Great South Bay
- Source of data = Robert Nuzzi, Supervisor of the Bureau of Marine Resources, SCDHS.

NYSDEC shellfish harvesting criteria:

- median value of total coliforms must be less than 70 MPN/100 ml
- no more than 10 percent of the samples may exceed a total coliform level of 330 MPN/100 ml
- median value of fecal coliforms must be less than 14 MPN/100 ml
- no more than 10 percent of the samples may exceed a fecal coliform level of 49 MPN/100 ml

Table B-2

Suffolk County Department of Health Department Coliform Data
March 1977 through March 1987

Sampling Date	Sta. 210	Sta. 230	Sta. 250	Sta. 260	Sta. 280	Sta. 290
07-Mar-77	10 / 10	<10 /<10	<10 /<10	<10 /<10		
13-Apr-77	<10 /<10		<10 /<10	<10 /<10		
25-Apr-77	10 / 10	20 / 10	410 / 40	<10 /<10		
27-Jun-77	20 / 10	10 / 10	10 / 10	10 / 10		
11-Jul-77	<10 /<10	<10 /<10	<10 /<10	<10 /<10		
04-Oct-77	420 / 10	310 / 10	20 / 10	20 / 10		
09-Nov-77	5400 /160	200 / 20		2000 / 50		
21-Nov-77	210 /120	10 / 10	60 / 10	50 / 10		
15-Dec-77	20 / 10	10 / 10	30 / 10	290 / 80		
02-May-79	<10 /<10	<10 /<10	<10 /<10	<10 /<10	<10 /<10	50 /<10
16-May-79	10 / 10	<10 /<10	<10 /<10	<10 /<10	<10 /<10	40 /<10
28-May-79	20 / 10	<10 /<10	100 / 20	<10 /<10	30 /<10	30 /<10
21-Jun-79	<10 /<10	<30 /<30	<10 /<10	<10 /<10	<30 /<30	10 /
11-Jul-79	80 / 10	<10 /<10	140 /<10	50 /<10	10 /<10	120 / 20
01-Aug-79	30 /<10	<10 /<10	/<10	/<10	/<10	500 / 10
22-Aug-79	40 / 10	<10 /<10	80 /<10	11000 / 10	40 / 10	420 /<10
18-Sep-79	<10 /<10	<10 /<10	<10 /<10	<10 /<10	10 /<10	20 / 20
25-Sep-79	30 /<10	<10 /<10	70 /<10	<10 /<10		<10 /<10
30-Oct-79	<10 /<10	<10 /<10	<10 /<10	<10 /<10	<10 /<10	<10 /<10
15-Nov-79	40 / 10	10 /<10	80 /<10	10 /<10	<10 /<10	50 / 10
26-Nov-79	60 / 30		40 / 10	<10 /<10		
27-Nov-79		<10 /<10			190 / 30	80 / 60
04-Jun-80	20 / 10		2400 /230	30 / 10	<10 /<10	20 / 10
18-Jun-80	4200 /<10	100 /	<10 /<10	20 /<10	80 /<10	190 /<10
17-Feb-81	<3 / <3	<3 / <3	21 / <3	4 / 4		<3 / <3
09-Mar-81	23 / 4	<3 / <3	43 / 43	7 / 4	11 / 7	9 / 4
01-Apr-81	4 / <3	4 / 4	<3 / <3			
06-May-81	9 / 15		9 / <3	<3 / <3		
12-Jul-83	<30 /<30		<30 /<30	<30 /<30	<30 /<30	<30 /<30
13-Jun-84	<30 /<30		<30 /<30	<30 /<30	<30 /<30	
19-Jun-84	70 / 40	<30 /<30	930 /150	<30 /<30	<30 /<30	40 /<30
08-Aug-84	<30 /<30	<30 /<30	230 / 40	<30 /<30	430 / 90	40 /<30
20-Aug-84	<30 /<30	<30 /<30	<30 /<30	<30 /<30	<30 /<30	40 /<30
25-Sep-84	23 / 23	4 / <3	9 / 4	23 / 23	<3 / <3	4 / <3
09-Oct-84	23 / <3	<3 / <3	9 / 4	9 / <3	23 / <3	23 / 9
21-Nov-84	23 / 9		43 / 15	<3 / <3	<3 / <3	
05-Dec-84	3 / <3		93 / 23	9 / 9	43 / 23	93 / 43

Table B-2 (continued)

Suffolk County Department of Health Department Coliform Data
March 1977 through March 1987 (page 2 of 2)

Sampling Date	Sta. 210	Sta. 230	Sta. 250	Sta. 260	Sta. 280	Sta. 290
08-May-85	15 / 9	<3 / <3	<3 / <3	<3 / <3	43 / 4	7 / 7
19-Jun-85	43 / 23	9 / <3	23 / <3	43 / 43	23 / 4	23 / 23
13-Aug-85	23 / 9					
03-Sep-85	23 / 23	<3 / <3	23 /	7 / 7	4 / <3	15 / 15
19-Nov-85	23 / 9	9 / 4	240 / 93	23 / 4	43 / 23	9 / 4
25-Mar-87	<3 / <3		<3 / <3	<3 / <3	<3 / <3	<3 / <3

NOTES:

- All values in units of MPN/100 ml
- For each sampling station, values are given for each station in terms of total coliform concentration / fecal coliform concentration
- see map for station locations: Stations 230, 260, and 290 are in the vicinity of the Town of Babylon barrier and bay island communities; Stations 210, 250, and 280 are located in the main portion of Great South Bay

SOURCE: Robert Nuzzi, Supervisor of the Bureau of Marine Resources, Suffolk County Department of Health Services.

C:\DBASE\CRUISE\GSB.DBF DATABASE

DATE	STAT	Loc.	TIME	DEPTH Ft.	SECCHI Ft.	TEMP °C	DO mg/l	SALINITY ‰	TOT. COLI. MPN/100ml	FEC. COLI. MPN/100ml	NH3_N (ug. atoms / liter	NO2_N	NO3_N	COMB. NO_N	TKN	TDKN	TDPO4_P	OPO4_P	TPO4_P	SI_O3)	TOC (mg./liter	DOC	IC	TSS	VSS	BOD5	BOD20)	Aureo Cells /ml.	Small Cells /ml.	Chlor Total	Chlor Filt.	COND	FLOW24	pH
03/07/77	210		1135	12.0	3.5	5.2	11.3	29.97	10	10	0.50	0.25	1.10		37.0	10.0	0.44	0.97	2.20															
03/07/77	220		950	45.0	18.0	1.6	10.7	32.88	<10	<10	1.40	0.15	0.40		15.0	<7.0	0.58	0.53	1.40															
03/07/77	230		1010	25.0	16.0	1.6	11.3	33.23	<10	<10	1.20	0.17	0.40		12.0	7.0	0.76	0.47	1.10															
03/07/77	240		1142	8.0	4.0	5.6	12.0	28.58	10	10	3.10	0.39	6.60		44.0	7.0	0.40	0.71	1.90															
03/07/77	250		1155	14.0	4.0	5.4	11.6	30.73	<10	<10	0.50	0.40	3.10		33.0		0.15	0.26	1.90															
03/07/77	260		1240	32.0	6.0	4.2	11.5	32.34	<10	<10	0.10	0.14	0.30		33.0	<7.0	0.50	0.50	1.70															
03/07/77	270		1305	6.0	3.5	5.0	12.1	31.65	10	10	0.20	0.27	2.80		28.0	<7.0	0.33	0.62	2.00															
04/13/77	210		1243	10.0	2.0	13.5		29.09	<10	<10	1.70	0.24	0.57		64.0	44.0	0.62	1.10	3.10															
04/13/77	220		1136	18.0	9.0	6.4		32.28	<10	<10	0.70	0.14	0.21		26.0	22.0	0.45	0.38	1.20															
04/13/77	230		1146	28.0	6.0	8.0		30.98			0.60	0.17	<0.14		30.0	26.0	0.67	0.24	1.90															
04/13/77	240		1250	5.0	3.0	13.6		27.94	<10	<10	1.80	0.37	5.30		70.0	27.0	0.80	0.93	2.80															
04/13/77	250		1258	6.0	3.0	13.8		29.14	<10	<10	0.90	0.28	2.70		57.0	19.0	0.71	0.79	2.60															
04/13/77	260		1344	15.0	5.0	11.6		31.87	<10	<10	0.80	0.15	0.14		43.0	15.0	0.67	1.00	2.90															
04/13/77	270		1320	5.0	3.0	14.6		30.56	<10	<10	0.80	0.17	0.42		46.0	15.0	0.67	0.81	2.30															
04/25/77	210		1107	17.0		10.1		29.48	10	10	3.20	0.22	0.50		44.0	38.0	1.40	1.00	2.30															
04/25/77	220		1026	42.0		7.2		31.09	10	<10	1.70	0.19	0.17		26.0	23.0	0.91	0.70	1.20															
04/25/77	230		1015	15.0		8.5		30.87	20	<10	1.30	0.14	0.21		15.0	15.0	0.82	0.72	1.50															
04/25/77	240		1208	6.0		12.3		26.80	160	10	7.80	0.39	5.10		41.0	28.0	1.10	0.84	2.50															
04/25/77	250		1150	13.0		12.5		26.41	410	40	21.00	0.41	8.70		35.0	35.0	0.87	0.80	2.30															
04/25/77	260		1131	16.0		11.8		30.66	<10	<10	4.90	0.25	0.43		23.0	23.0	1.40	1.30	2.50															
04/25/77	270		1140	4.0		12.6		28.73	160	20	10.00	0.38	3.40		28.0	23.0	0.82	0.96	2.50															
06/27/77	210		1250	10.0	5.0	24.8		30.61	20	10	0.70	0.15	<0.14					0.38																
06/27/77	220		1206	20.0	13.0	17.5		32.05	10	10	0.20	0.12	<0.14					0.33																
06/27/77	230		1218	20.0	4.0	19.7		31.27	10	10	0.50	0.17	<0.14					0.40																
06/27/77	240		1421	10.0	7.0	24.4		29.17	10	10	1.30	0.35	1.40					0.56																
06/27/77	250		1403	6.0	6.0	24.7		29.83	10	10	2.80	0.31	1.20					0.68																
06/27/77	260		1308	17.0	6.0	23.2		31.76	10	10	0.90	0.15	<0.14					0.84																
06/27/77	270		1315	6.0	6.0	24.0		29.92	50	10	1.70	0.30	0.64					0.70																
07/11/77	210		1100	12.0		24.7		31.11	<10	<10	2.70	0.13	0.36					0.75																
07/11/77	220		945	20.0	20.0	20.8		31.18	<10	<10	0.90	0.12	0.29					0.47																
07/11/77	230		1000	12.0		21.0	8.1	31.50	<10	<10	2.20	0.11	0.29					0.53																
07/11/77	240		1204			25.1		29.91	<10	<10	1.90	0.16	0.14					0.24																
07/11/77	250		1146			24.4		30.57	<10	<10	8.80	0.36	1.20					1.10																
07/11/77	260		1126			24.7		31.93	<10	<10	3.70	0.13	0.14					1.10																
07/11/77	270		1135	3.0		24.8		30.18	<10	<10	10.60	0.39	1.40					1.40																
07/27/77	210		842	14.0	4.0	21.2		31.23			0.90	0.27	0.14		31.0	22.0	1.20	1.10	2.90															
07/27/77	220		750	30.0	9.0	17.3		31.86			1.10	0.28	0.86		7.0	7.0	0.97	0.91	1.20															
07/27/77	230		802	28.0	6.0	16.5	5.9	31.76			2.00	0.29	0.79		19.0		1.20	0.97	2.10															
07/27/77	240		938	5.0	4.0	22.1		29.49			23.00	0.77	4.30		36.0	29.0	1.70	1.40	2.60															
07/27/77	250		920	5.0	5.0	22.4	6.8	30.64			7.50	0.40	1.30		22.0	36.0	1.70	1.40	2.00															
07/27/77	260		859	16.0	7.0	20.0		31.30			2.00	0.26	0.29		25.0	32.0	1.70	1.40	2.80															
07/27/77	270		907	6.0	6.0	21.0		30.71			4.90	0.41	1.60		51.0	32.0	1.70	1.50	2.10															
08/09/77	210		1200	15.0	7.0	27.4		29.26			2.50	0.41	2.20		14.0	22.0	0.73	0.46	1.50															
08/09/77	220		1223	25.0	20.0	19.6		31.68			0.60	0.11	0.14		29.0	30.0																		
08/09/77	230		1232	17.0	5.0	23.8		30.91			0.30	0.11	0.14		27.0		1.00	0.69	1.60															
08/09/77	240		1045	7.0	7.0	27.0		27.75			28.00	0.95	5.90		58.0	74.0	1.20	1.10	2.50															
08/09/77	250		1050	15.0	8.0	27.3		28.22			33.00	1.00	8.90		36.0		1.40	1.20	2.20															
08/09/77	260		1128	23.0	7.0	25.8		30.60			1.40	0.13	0.14		7.0	22.0	1.80	1.60	2.60															
[illegible]	270		1118	[illegible]	[illegible]	27.4		30.34			[illegible]	0.20	[illegible]		33.0		[illegible]	[illegible]	2.20															
[illegible]	210		1125	[illegible]	[illegible]	22.8		28.96			[illegible]	0.12	[illegible]		7.0	[illegible]	[illegible]	[illegible]	1.60															

C:\DBASE\CRUISE\GSB.DBF DATABASE

DATE	STAT	Loc.	TIME	DEPTH Ft.	SECCHI Ft.	TEMP ºC	DO mg/l	SALINITY ‰	TOT. COLI. MPN/100ml	FEC. COLI. MPN/100ml	NH3_N (	NO2 N	NO3_N	COMB. NO N ug. atoms / liter	TKN	TDKN	TDPO4_P	OPO4_P	TPO4_P	SI_O3)	TOC (	DOC	TC	TSS mg./liter	VSS	BOD5	BOD20)	Aureo Cells /ml.	Small Cells /ml.	Chlor Total	Chlor Filt.	COND	FLOW24	pH
08/23/77	220		1140		7.0	20.6		31.61			0.50	0.10	0.14		7.0	7.0	0.85	0.83	1.20															
08/23/77	230		1123		5.0	21.2		30.23			1.60	0.34	0.83		14.0	7.0	0.89	0.53	1.50															
08/23/77	240		1216		3.5	23.6		28.17			1.70	0.89	3.20		42.0	7.0	1.10	1.40	2.80															
08/23/77	250		1225		4.0	23.5		28.67			9.20	0.92	5.50		21.0	10.0	1.20	1.30	2.40															
08/23/77	260		1245		8.0	22.0		30.03			4.60	0.16	0.21		11.0	7.0	1.60	1.20	1.80															
08/23/77	270		1235		6.0	22.3		30.10			12.00	0.60	2.70		13.0	7.0	1.10	1.10	1.30															
09/07/77	210		1100		4.0	23.5		30.52			0.20	0.15	0.14		9.0	7.0	1.10	0.60	1.70															
09/07/77	220		1132		25.0	20.0		31.57			0.20	0.09	0.14		7.0	7.0	0.80	0.67	1.10															
09/07/77	230		1118		7.0	23.4		30.39			0.20	0.11	0.14		15.0	7.0	1.10	0.58	1.90															
09/07/77	240		1015		3.0	23.7		28.74			0.60	0.15	0.36		23.0	21.0	0.69	0.46	1.90															
09/07/77	250		1020		3.0	24.1		29.34			0.80	0.35	2.10		20.0	7.0	0.84	0.50	2.10															
09/07/77	260		1043		7.0	23.6		31.35			3.50	0.17	0.29		15.0	7.0	1.90	1.50	2.80															
09/07/77	270		1035		6.0	23.4		30.21			0.60	0.13	0.14		7.0	7.0	0.88	0.48	2.30															
09/19/77	210		1030	18.0	6.0	21.6		30.62			1.50	0.15	0.15		30.0	27.0	0.73	0.50	1.50															
09/19/77	220		950	37.0	9.0	18.8		31.98			1.00	0.20	0.39		12.0	7.0	0.95	0.94	1.50															
09/19/77	230		929	24.0	4.0	20.8		30.90			1.20	0.12	0.16		23.0	16.0	0.95	0.77	1.70															
09/19/77	240		1138	5.0	4.0	21.9		29.29			1.10	0.14	0.14		27.0	12.0	0.66	0.34	1.70															
09/19/77	250		1120	6.0	3.0	21.9		30.18			0.40	0.41	3.30		30.0	12.0	0.63	0.43	2.00															
09/19/77	260		1058	16.0	6.5	21.5		31.31			4.00	0.30	0.47		16.0	8.0	1.30	1.00	1.80															
09/19/77	270		1108	6.0	5.0	22.1		30.78			0.30	0.22	0.39		30.0	8.0	0.80	0.77	1.80															
10/04/77	210		1137	10.0	4.0	14.4		29.95	420	10	0.70	0.20	0.14		7.0		0.40	0.39	1.70															
10/04/77	220		1102	32.0	10.0	17.0		31.58	10	10	1.00	0.45	0.99		7.0	7.0	0.80	0.85	1.50															
10/04/77	230		1110	19.0	5.0	16.5		30.48	310	10	0.30	0.28	0.28		7.0	7.0	0.44	0.63	1.90															
10/04/77	240		1231	8.0	3.0	15.7		27.56	160	10	9.50	1.30	12.00		22.0	39.0	0.53	0.42	1.60															
10/04/77	250		1220	12.0	4.0	15.7		29.94	20	10	35.00	1.20	10.00		97.0	29.0	0.58	0.52	1.90															
10/04/77	260		1158	15.0	4.0	15.2		31.14	20	10	8.20	0.61	1.70		10.0		1.00	1.10	1.70															
10/04/77	270		1208	12.0	4.0	14.3		30.18	10	10	22.00	1.00	5.00		29.0	10.0	0.82	0.85	1.70															
10/24/77	210		1120	18.0	3.0	11.9		30.11			2.80	0.87	4.40		32.0	16.0	0.37	0.43	1.20															
10/24/77	220		1042	44.0	12.0	14.4		32.73			3.90	0.66	2.80		8.0	17.0	1.10	1.10	1.50															
10/24/77	230		1024	22.0	10.0	14.4		32.69			4.10	0.64	2.70		15.0		1.10	1.10	1.10															
10/24/77	240		1238	5.0	4.0	13.1		28.89			14.00	1.60	14.00		42.0	31.0	0.45	0.34	1.10															
10/24/77	250		1216	14.0	4.0	12.6		29.84			6.90	1.40	9.80		20.0	27.0	0.26	0.36	1.20															
10/24/77	260		1147	14.0	6.5	11.8		31.56			4.20	0.93	3.90		30.0	27.0	0.74	0.64	1.40															
10/24/77	270		1202	6.0	5.5	12.3		30.13			7.70	1.30	9.00		26.0	14.0	0.48	0.49	1.00															
11/09/77	210		1355	15.0	2.0	13.0		26.19	5400	160	5.80	0.32	2.70		41.0	15.0	0.62	0.72	2.50															
11/09/77	220		1300	40.0	5.0	13.5		30.91	10	10	2.40	0.69	3.00		14.0	7.0	1.20	1.10	1.20															
11/09/77	230		1245	20.0	3.5	13.3		28.74	200	20	3.20	0.42	1.60		23.0	7.0	0.86	0.98	2.30															
11/09/77	240		1459	8.0	2.0	13.4		25.84	2300	130	6.90	0.39	2.50		34.0	21.0	0.74	0.96	2.40															
11/09/77	250		1500	10.0	2.0	13.4		24.63			9.80	0.57	5.60		42.0	28.0	0.70	1.00	2.50															
11/09/77	260		1420	20.0	3.0	13.3		26.82	2000	50	1.90	0.18	0.14		33.0	12.0	0.66	0.76	2.40															
11/09/77	270		1435	10.0	1.5	13.4		25.13	5100	450	7.70	0.48	4.00		42.0	24.0	0.70	0.98	2.70															
11/21/77	210		1054	22.0	3.0	8.6		29.63	210	120	3.00	0.72	3.30		41.0	22.0	0.34	0.53	2.10															
11/21/77	230		1015	20.0	8.0	11.9		32.26	10	10	3.90	0.74	2.70		16.0		1.10	1.10	1.50															
11/21/77	240		1158	7.0	3.0	8.2		29.45	70	10	14.00	0.96	10.00		42.0	35.0	0.60	0.65	1.70															
11/21/77	250		1144	15.0	3.0	8.2		29.86	60	10	13.00	0.93	9.80		39.0	23.0	0.79	0.75	1.50															
11/21/77	260		1119	15.0	5.0	8.9		31.16	50	10	7.70	0.81	4.50		30.0	26.0	0.90	0.90	1.70															
11/21/77	270		1131	4.0	3.0	8.7		31.06	10	10	9.60	0.91	5.70		29.0	27.0	1.00	1.00	1.50															
12/15/77	210		1225	6.0	4.0	4.0	10.0	29.68	20	10	6.50	0.54	8.50		22.0	37.0	0.69	0.49	1.70															
12/15/77	230		1133	20.0	7.0	7.5	8.9	31.68	10	10	4.10	0.33	7.10		18.0	14.0	1.60	1.10	1.80															
12/15/77	240		1130	9.0	4.0	2.9	9.5	27.88	450	130	28.00	0.83	18.00		43.0	32.0	0.59	0.49	2.10															

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DATE	STAT	Loc.	TIME	DEPTH Ft.	SECCHI Ft.	TEMP °C	DO mg/l	SALINITY ‰	TOT. COLI. MPN/100ml	FEC. COLI.	NH3 N (	NO2 N	NO3 N	COMB. NO N ug. atoms / liter	TKN	TDKN	TDPO4_P	OPO4 P	TPO4_P	SI_O3)	TOC (	DOC	TC	TSS mg./liter	VSS	BOD5	BOD20)	Aureo Cells /ml.	Small Cells /ml.	Chlor Total	Chlor Filt.	COND	FLOW24	pH
12/15/77	250		1320	6.0	5.0	4.8	7.9	30.26	30	10	16.00	0.76	13.00		36.0	23.0	0.93	0.71	1.50															
12/15/77	260		1225	15.0	4.5	6.7	9.7	31.40	290	80	6.80	0.54	7.10		19.0	20.0	1.10	0.93	1.70															
12/15/77	270		1307	7.0	6.5	7.3	5.8	30.66	290	120	8.60	0.65	9.10		30.0	29.0	1.00	0.82	2.00															
03/29/78	210		1212		5.0	8.2		27.32			1.30	0.36	2.90		57.0	14.0	0.60	0.50	1.40															
03/29/78	220		1126	40.0	11.0	4.9		31.44			0.20	0.10	<0.14		7.0			0.37	0.82															
03/29/78	230		1116	30.0	6.5	5.5		31.40			2.10	0.12	0.15		14.0	<7.0	0.70	0.42	0.90															
03/29/78	240		1335	4.0	4.0	9.3		24.88			10.00	0.56	23.40		59.0	14.0	0.52	0.50	1.40															
03/29/78	250		1325	4.0	4.0	8.9		26.91			6.20	0.50	15.50		26.0	26.0	0.58	0.41	0.94															
03/29/78	253		1137	25.0	9.0	5.3					0.50	0.27	0.29		19.0		0.73	0.64	1.20															
03/29/78	260		1256	15.0	6.0	8.1		29.80			1.20	0.23	2.10		13.0	<7.0	0.81	0.51	1.30															
03/29/78	260		1310	6.0	6.0	9.3		28.70																										
03/29/78	270		1310								2.20	0.38	8.30		11.0	7.0	0.54	0.42	0.92															
04/10/78	210		1415	5.0	6.0			30.15			0.90	0.12	<0.14		15.0	7.0	0.56	0.24	0.56															
04/10/78	220		1250	33.0	8.0	5.0		31.57			1.20	0.14	<0.14		22.0	14.0	0.88	0.59	0.88															
04/10/78	230		1225		6.5			31.73			1.50	0.17	0.14		41.0	<7.0	1.00	0.95	1.00															
04/10/78	240		1520		5.0	9.7		28.85			4.30	0.23	4.80		41.0	26.0	0.32	0.38	0.32															
04/10/78	250		1510		7.0	8.9		30.01			1.60	0.17	0.29		39.0	14.0	0.48	0.38	0.48															
04/10/78	253		1305		7.0	5.0		31.48			0.80	0.15	0.14			7.0	0.84	0.66	1.90															
04/10/78	260		1445	5.0	6.0			31.32			0.60	0.14	<0.14		35.0	22.0	0.46	0.33	1.20															
04/10/78	270		1550		5.0	9.2		30.20			1.10	0.17	0.29		33.0	<7.0	0.34	0.43	1.20															
04/24/78	210		1045	18.0	7.0	11.0		29.45			1.00	0.18	0.18		58.0	39.0	0.72	0.65	1.50															
04/24/78	220		1104	42.0	11.0	7.8		31.08			1.10	0.16	<0.14		15.0	10.0	0.55	0.33	0.74															
04/24/78	230		1030	26.0	7.0	8.3		30.81			0.80	0.16	<0.14		21.0	12.0	0.50	0.50	1.30															
04/24/78	240		1245	11.0	5.0	12.2		28.55			3.00	0.26	3.20		33.0	24.0	0.50	0.58	1.50															
04/24/78	250		1235	10.0	6.0	11.1		29.50			0.70	0.20	0.66		27.0		0.55	0.56	1.20															
04/24/78	253		1047	32.0	9.0	7.9		30.85			1.60	0.17	0.14		51.0	24.0	0.44	0.41	0.99															
04/24/78	260		1207	18.0	8.0	9.9		30.71			0.70	0.19	<0.14		23.0	19.0	0.59	0.56	1.20															
04/24/78	270		1222	15.0	6.0	11.4		29.46			1.50	0.25	3.00		53.0	33.0	0.81	0.48	1.40															
05/22/78	210		1314		6.0	18.5		26.97			0.70	0.15	<0.14		12.0		0.78	0.58	1.60															
05/22/78	220		1217		20.0	11.2		30.55			0.50	0.15	<0.14		<7.0	<7.0	0.70	0.41																
05/22/78	230		1200		12.0	11.0		30.66			0.30	0.14	<0.14		<7.0	<7.0	0.51	0.45	0.94															
05/22/78	240		1423		4.0	18.2		26.94			0.70	0.34	3.40		32.0	10.0	0.57	0.72	2.10															
05/22/78	250		1402		4.0	18.7		27.83			0.80	0.26	0.50		26.0		0.78	0.67	1.80															
05/22/78	253		1132		15.0	12.0		30.50			0.20	0.12	<0.14		7.0	7.0	0.50	0.39	0.50															
05/22/78	260		1340		5.0	17.6		25.64			0.50	0.14	<0.14		25.0	14.0	0.76	0.58	0.76															
05/22/78	270		1350		4.0	18.4		28.52			0.60	0.16	0.14		22.0	7.0	0.80	0.50	0.80															
06/06/78	210		1347		5.0	21.2		27.54			0.70	0.11	<0.14		76.0	<7.0	0.91	1.30	1.70															
06/06/78	220		1230		30.0	15.8		30.41			0.10	0.08	<0.14		7.0	<7.0		0.40	0.48															
06/06/78	230		1203		8.5	14.5		30.08			0.60	0.11	<0.14		97.0	8.0	0.37	0.69	0.97															
06/06/78	253		1250		12.0	15.8					0.20	0.09	<0.14		19.0	<7.0	0.35	0.47	0.60															
06/06/78	260		1430		4.0	20.2		29.89			0.60	0.17	<0.14		30.0	<7.0	0.79	0.88	1.40															
06/06/78	270		1442		4.0	20.8		29.09			0.90	0.11	<0.14		26.0	10.0	0.53	1.40	1.20															
06/21/78	210		1340	11.0	8.0	21.9		29.49			0.30	0.12	<0.14		7.0		0.37	0.64	1.00															
06/21/78	230		1255	22.0	11.0	14.2					0.20	0.11	<0.14		7.0		0.32	0.51	0.98															
06/21/78	240		1422	5.0	3.5	22.6		28.29			0.20	0.17	<0.14		22.0	11.0	0.37	0.93	1.60															
06/21/78	250		1414	5.0	4.0	21.2		30.13			<0.20	0.16	<0.14		<7.0	<7.0	0.28	0.57	1.10															
06/21/78	253		1310	35.0	10.0	15.5		30.66			<0.20	0.16	<0.14		<7.0	<7.0	0.37	0.48	0.72															
06/21/78	260		1401	10.0	5.0	19.0		30.66			0.40	0.17	<0.14		<7.0	<7.0	0.51	0.62	3.60															
[illegible]/78	27[illegible]		1408	[illegible]	[illegible]	20.[illegible]		30.10			[illegible]	0.1[illegible]	[illegible]		[illegible].0	<[illegible]	[illegible].37	[illegible]	3.60															
07/05/78	210		1249	6.0				27.95			1.20	0.14	<0.14		19.0	18.0	0.63	0.58	0.98															

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DATE	STAT	Loc.	TIME	DEPTH ft.	SECCHI ft.	TEMP °C	DO mg/l	SALINITY ‰	TOT. COLI. MPN/100ml	FEC. COLI.	NH3_N (	NO2_N	NO3_N	COMB. NO_N ug. atoms / liter	TKN	TDKN	TDPO4_P	OPO4_P	TPO4_P	SI_O3)	TOC (	DOC	TC	TSS mg./liter	VSS	BOD5	BOD20)	Aureo Cells /ml.	Small Cells /ml.	Chlor Total	Chlor Filt.	COND	FLOW24	pH
07/05/78	220		1205					30.34																										
07/05/78	230		1152	20.0	5.5	17.2		30.31			1.10	0.14	0.15		25.0	10.0	0.48	0.62	0.79															
07/05/78	240		1034	12.0				25.76			9.50	0.38	4.80		51.0	31.0	0.81	0.67	0.92															
07/05/78	250		1054	8.0		21.5		26.82			6.10	0.28	1.80		29.0		0.63	0.52	1.10															
07/05/78	253		1220	40.0	8.5			30.36			1.00	0.13	0.15		36.0	36.0	1.60	0.57	1.30															
07/05/78	260		1153	14.0				28.76			2.90	0.15	<0.14		19.0	19.0	0.78	0.78	1.10															
07/05/78	270		1134	6.0				27.80			0.40	0.14	0.15		17.0		0.39	0.43	0.83															
07/17/78	210		1238		8.0	22.3		29.26			1.50	0.13	<0.14		34.0	21.0	1.00	0.69	1.40															
07/17/78	230		1420		8.0	21.5		29.32			2.10	0.15	<0.14		40.0	17.0	0.89	0.57	1.30															
07/17/78	240		1027		7.0	22.3		27.37			25.00	0.50	4.40		43.0	50.0	0.97	0.97	1.50															
07/17/78	250		1046		6.0	22.3		28.68			7.80	0.29	1.70		39.0	37.0	0.90	0.59	1.50															
07/17/78	260		1119		6.0	22.0					1.80	0.19	0.29		34.0	17.0	0.97	0.76	1.60															
07/17/78	270		1137		7.0	21.1					2.20	0.16	1.14		33.0		1.30	0.91	1.70															
08/01/78	210		1251	16.0	4.0	20.3					0.70	0.11	<0.14		33.0	17.0	1.20	0.72	1.90															
08/01/78	230		1150	26.0	16.0	19.6					0.30	0.09	<0.14		11.0		0.65	0.46	0.93															
08/01/78	240		1020	11.0	6.0	22.7					40.00	0.41	3.00		49.0	37.0	1.30	0.98	1.70															
08/01/78	250		1016	6.0	5.0	21.7					21.00	0.40	2.60		40.0	37.0	1.20	0.87	1.60															
08/01/78	260		1147	18.0	6.0	20.7					2.50	0.12	<0.14		33.0	13.0	1.50	1.00	2.40															
08/01/78	270		1200	8.0	6.0	21.0					2.40	0.11	<0.14		22.0	13.0	1.20	0.79	1.60															
08/14/78	210		1356		4.0	24.5		26.44			2.00	0.38	1.60		42.0	16.0	0.69	0.78	1.90															
08/14/78	230		1430		6.0	24.4		28.72			0.40	0.17	<0.14		31.0	13.0	0.89	0.60	1.70															
08/14/78	240		1119		6.0	25.3		23.80			31.00	0.95	9.10		51.0	37.0	1.20	1.00	2.00															
08/14/78	250		1153		5.0	25.4		25.28			18.00	0.81	5.70		40.0	23.0	1.10	0.89	1.80															
08/14/78	260		1255		6.0	25.0		28.56			3.90	0.29	0.22		33.0	14.0	1.90	2.10	2.90															
08/14/78	270		1232		5.0	25.1		26.84			11.00	0.58	7.50		62.0	20.0	1.30	2.60	3.60															
08/31/78	210		1103	5.0		24.3		28.77			1.70	0.17	<0.14		31.0	21.0	1.20	0.80	2.20															
08/31/78	230		1340	24.0	6.0	22.5		29.77			0.30	0.14	<0.14		28.0	15.0	0.94	0.78	1.80															
08/31/78	240		830	10.0		24.8		27.71			2.30	0.68	6.20		44.0	21.0	0.86	0.90	2.50															
08/31/78	250		847	13.0		24.7		28.60			5.40	0.58	4.00		41.0	24.0	1.10	1.00	2.40															
08/31/78	260		1006	17.0		24.1		30.32			1.50	0.18	<0.14		21.0	17.0	1.60	1.30	2.40															
08/31/78	270		930	15.0		24.7		29.41			2.00	0.34	1.00		34.0	20.0	1.20	1.00	2.00															
09/26/78	210		1144	9.0	7.0	17.7		28.89			0.50	0.11	<0.14		21.0	13.0	0.49	0.34	0.81															
09/26/78	230		930		9.0	18.2		31.23			1.10	0.15	0.14		13.0	13.0	1.11	0.94	1.42															
09/26/78	240		926	14.0	7.0	17.8		28.49			8.40	0.68	4.10		21.0		0.70	0.70	1.10															
09/26/78	250		939	8.0	7.0	17.6		28.69			6.50	0.60	3.40		21.0		0.73	0.57	1.20															
09/26/78	260		1043	16.0	7.0	17.4		30.43			0.60	0.15	<0.14		17.0	13.0	1.10	0.86	1.70															
09/26/78	270		1025	7.0	7.0	17.4		29.85			0.90	0.22	0.50		17.0	10.0	0.90	0.73	1.10															
10/12/78	230		1105	13.0	10.0	16.6		31.44			1.40	0.27	0.64		25.0	7.0	1.50	1.20	1.90															
11/15/78	210		1136			11.3		30.24			2.80	0.23	0.40		21.0	20.0	0.55	0.46	0.93															
11/15/78	230		1015		15.0	12.4		31.44			2.20	0.29	0.71		23.0	13.0	0.97	0.93	1.80															
11/15/78	240		1255		7.0	12.0		29.64			19.00	0.43	5.20		30.0	27.0	0.85	0.72	1.10															
11/15/78	250		1235		8.0	12.2		30.47			9.00	0.33	3.30		54.0	36.0	0.81	0.72	1.30															
11/15/78	260		1243			12.4		31.63			4.00	0.26	0.68		17.0	17.0		1.00	1.40															
11/15/78	270		1307			12.3		30.74			5.70	0.29	2.70		31.0	27.0	0.81	0.67	0.89															
03/19/79	240		1135			5.3		25.32	43	43	20.00	0.54	22.00		21.0	<7.0	0.24	0.48	0.94															
03/19/79	250		1115			5.0		25.78			23.00	0.53	25.00		14.0	<7.0	0.24	0.42	0.72															
04/18/79	210		1208		5.0	10.4		26.58			7.90	0.46	7.40		48.0			0.69	1.40															
04/18/79	230		1257		7.0	7.0		31.25			2.40	0.20	1.40		<7.0	<7.0		0.69	1.00															
04/18/79	240		1234		7.0	10.4		24.74			11.00	0.61	17.00		31.0			0.46	0.95															
04/18/79	250		1032		8.0	9.8		25.72			12.00	0.59	14.00		41.0			0.20	0.91															

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DATE	STAT	Loc.	TIME	DEPTH Ft.	SECCHI Ft.	TEMP °C	DO mg/l	SALINITY ‰	TOT. COLI. MPN/100ml	FEC. COLI.	NH3_N (ug. atoms / liter	NO2_N	NO3_N	COMB. NO_N	TKN	TDKN	TDPO4_P	DPO4_P	TPO4_P)	SI_O3 (	TOC	DOC	TC	TSS mg./liter	VSS	BOD5	BOD20)	Aureo Cells /ml.	Small Cells /ml.	Chlor Total	Chlor Filt.	COND	FLOW24	pH
04/18/79	260		1117		8.0	8.9		29.47			2.40	0.15	0.16		15.0			0.51	1.20															
04/18/79	270		1100		6.0	9.5		28.17			5.00	0.39	4.40		20.0			0.44	0.89															
04/18/79	280		1157		4.5	9.2		25.94			1.50	0.42	6.20		22.0			0.47	1.00															
04/18/79	290		1210		5.0	9.1		27.12			2.70	0.43	5.30		<7.0	<7.0		0.51	1.10															
04/18/79	300		1335		4.0	9.4		26.65			2.00	0.36	1.80		18.0			0.53	0.97															
05/02/79	210		1159		5.5	15.1		27.80	<10	<10	2.40	0.31	2.70		47.0			0.81	4.60															
05/02/79	230		1410		8.0	10.1		30.71	<10	<10	1.30	0.16	1.80		25.0			0.72	1.70															
05/02/79	240		1209		5.0	15.8		27.53	10	10	5.60	0.36	5.70		39.0			0.63	2.00															
05/02/79	250		1217		5.0	15.6		28.56	<10	<10	3.40	0.37	3.10		26.0			0.49	2.00															
05/02/79	260		1242		5.5	14.0		30.11	<10	<10	0.60	0.18	0.38		11.0			0.69	2.40															
05/02/79	270		1231		6.5	15.4		28.95	<10	<10	2.60	0.27	2.70		25.0			0.47	2.10															
05/02/79	280		1148		4.0	15.5		25.61	<10	<10	1.00	0.15	0.23		39.0			0.53	1.80															
05/02/79	290		1302		5.0	15.5		27.47	50	<10	1.00	0.20	0.53		25.0			0.75	2.00															
05/02/79	300		1450			15.3		26.29	<10	<10	0.90	0.16	0.84		25.0			0.56	2.00															
05/16/79	210		1020		4.0	17.6		27.41	10	10	2.30	0.22	1.20		22.0	22.0	0.70	0.34	1.60															
05/16/79	230		1340		8.0	14.3		29.62	<10	<10	0.80	0.15	0.52		<7.0	<7.0	0.56	0.47	1.20															
05/16/79	240		1304		6.0	19.6		25.87	<10	<10	19.00	0.52	8.00		80.0	75.0	0.74	0.43	1.40															
05/16/79	250		1200		6.0	18.9		26.50	<10	<10	20.00	0.47	7.30		58.0	36.0	0.68	0.42	1.60															
05/16/79	260		1117		6.0	16.5		28.75	<10	<10	5.60	0.21	1.30		36.0	28.0	1.30	0.75	1.90															
05/16/79	270		1135		5.0	18.3		27.13	20	<10	10.00	0.39	5.70		22.0	22.0	0.62	0.41	0.97															
05/16/79	280		1140		5.0	18.3		25.90	<10	<10	1.10	0.17	1.30		22.0	12.0	0.58	0.39	1.20															
05/16/79	290		1001		5.0	16.6		27.28	40	10	5.30	0.22	2.40		44.0	31.0	0.73	0.39	1.80															
05/16/79	300		1430		6.0	18.1		23.56	<10	<10	1.10	0.13	0.52		36.0	12.0	0.83	0.39	1.30															
05/28/79	210		845		4.0	16.9		27.18	20	10	1.00	2.90	0.16		30.0	29.0	0.65	0.82	1.90															
05/28/79	230		1125			14.2		29.77	<10	<10	0.70	0.16	0.21		55.0	10.0	0.66	0.67	1.50															
05/28/79	240		1055		3.0	17.5		25.72	580	30	23.00	1.00	8.90		41.0	43.0	0.65	0.85	1.60															
05/28/79	250		1030		3.0	17.2		26.74	100	20	21.00	0.78	7.10		59.0	57.0	0.76	0.64	1.90															
05/28/79	260		950		4.0	16.0		29.26	<10	<10	1.90	0.18	0.64		27.0		0.82	0.76	1.70															
05/28/79	270		1005		3.5	16.6		28.79	20	<10	2.90	0.30	2.10		30.0		0.72	0.56	1.80															
05/28/79	280		1055		4.0	17.2		25.24	30	<10	3.70	0.42	3.60		98.0	13.0	0.56	0.27	1.60															
05/28/79	290		825		4.0	17.0		26.56	30	<10	1.70	0.23	1.40		56.0		0.64	0.75	2.00															
05/28/79	300		1300		6.0	17.0		25.65	<10	<10	0.20	0.09	<0.14		100.0	17.0	0.52	0.45	1.30															
06/21/79	210		1040		4.0	21.7		28.49	<10	<10	1.00	0.12	<0.14		17.0	10.0	0.51	0.49	2.00															
06/21/79	230		1250		8.0	18.7		29.72	<30	<30	<0.20	0.12	<0.14		16.0	<7.0	0.48	0.50	0.95															
06/21/79	240		1305		6.0	23.5		26.63	<10	<10	4.00	0.65	6.90		46.0	20.0	1.20	0.40	1.90															
06/21/79	250		1240		5.0	23.1		29.18	<10		1.20	0.16	0.29		16.0	12.0	0.70	0.41	1.30															
06/21/79	260		1140		5.0	22.2		22.20	<10		2.40	0.12	0.22		21.0	20.0	1.10	0.79	1.40															
06/21/79	270		1205		7.0	22.6		22.60	<10	<10	2.30	0.15	0.29		22.0	10.0	0.73	0.47	0.93															
06/21/79	280		1150		3.0	22.7		22.70	<30	<30	0.20	0.15	<0.14		21.0	12.0	0.81	0.73	1.80															
06/21/79	290		1015		5.0	21.1		21.10	10		2.50	0.13	0.29		30.0	9.0	0.48	0.38	1.60															
06/21/79	300		1340		4.5	22.5		22.50	<30	<30	0.50	0.15	<0.14		24.0			0.61	2.30															
07/11/79	210		1232		5.0	21.9		29.82	80	10	<0.20	0.10	<0.14		28.0	<7.0	0.50	0.48	1.80															
07/11/79	230		1257		11.0	18.0		31.27	<10	<10	<0.20	0.07	<0.14		8.0	<7.0	0.43	0.48	1.60															
07/11/79	240		1109		7.0	22.5		28.29	90	20	3.10	0.34	3.00		30.0	<7.0	0.83	0.72	2.10															
07/11/79	250		1146		7.0	22.2		29.02	140	<10	5.20	0.41	3.20		22.0	17.0	1.30	0.88	1.80															
07/11/79	260		1216		6.0	19.5		31.10	50	<10	0.20	0.10	<0.14		7.0	7.0	1.20	0.90	1.80															
07/11/79	270		1208		7.0	21.9		30.25	200	10	0.30	0.14	0.52		26.0	<7.0	1.20	0.84	1.80															
07/11/79	280		1052		3.5	21.8		27.82	10	<10	0.20	0.12	<0.14		29.0	18.0	0.85	0.79	2.20															
07/11/79	290		1240		5.0	20.8		30.13	120	20	0.20	0.09	<0.14		15.0	<7.0	0.62	0.49	1.40															
07/11/79	300		1347		4.0	[illegible]		28.60	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		25.0	[illegible]	0.62	[illegible]	2.10															

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DATE	STAT	LOC.	TIME	DEPTH Ft.	SECCHI Ft.	TEMP °C	DO mg/l	SALINITY ‰	TOT. COLI. MPN/100ml	FEC. COLI. MPN/100ml	NH3 N (	NO2 N	NO3 N	COMB. NO N ug. atoms / liter	TKN	TDKN	TDPO4 P	OPO4 P	TPO4 P	SI O3)	TOC (	DOC	TC	TSS mg./liter	VSS	BOD5	BOD20)	Aureo Cells /ml.	Small Cells /ml.	Chlor Total	Chlor Filt.	COND	FLOW24	pH
08/01/79	210		1222		6.0	28.0		30.32	30	<10	0.30	0.14	<0.14		25.0			0.91	2.40															
08/01/79	230		1330		11.0	24.5		31.00	<10	<10	0.30	0.09	<0.14		<7.0	<7.0		0.49	0.92															
08/01/79	240		1116		4.0	28.7		28.46	<100	<10	0.30	0.19	<0.14		30.0			1.10	3.30															
08/01/79	250		1200			28.6		28.98		<10	0.30	0.18	<0.14		25.0			0.99	2.80															
08/01/79	260		1206		8.0	27.3		30.69		<10	0.50	0.13	<0.14		15.0			1.80	2.90															
08/01/79	270		1254		5.0	28.3		29.67	10	<10	0.30	0.14	<0.14		25.0			1.20	2.50															
08/01/79	280		1058		2.5	28.4		27.57		<10	0.40	0.20	<0.14		35.0	16.0	1.30	1.20	2.60															
08/01/79	290		1235		4.5	27.5		29.36	500	10	0.20	0.14	<0.14		22.0			0.99	2.30															
08/01/79	300		1410		4.5	27.7		28.71	400	<10	0.20	0.15	<0.14		30.0			0.84	2.80															
08/22/79	210		1205			22.3		29.72	40	10	0.30	0.15	<0.14		8.0	12.0	0.86	0.62	1.30															
08/22/79	230		1255			19.4		31.51	<10	<10	0.50	0.09	<0.14		<7.0	<7.0	0.54	0.65	1.30															
08/22/79	240		1105			22.2		28.64	580	<10	3.40	0.79	5.80		22.0	11.0	0.99	0.74	2.00															
08/22/79	250		1115			22.2		29.56	80	<10	1.40	0.50	2.80		<7.0	<7.0	0.95	0.74	4.00															
08/22/79	260		1140			22.0		30.95	11000	10	<0.20	0.11	<0.14		<7.0	<7.0	1.20	0.80	1.50															
08/22/79	270		1125			22.2		30.35			1.20	0.30	2.40		9.0	16.0	0.89	0.93	1.70															
08/22/79	280		1045			22.4		27.71	40	10	0.20	0.22	0.65		23.0	22.0	0.80	0.65	1.90															
08/22/79	290		1215			21.9		29.41	420	<10	<0.20	0.12	<0.14		8.0	22.0	0.68	0.55	1.60															
08/22/79	300		1340			22.2		28.63	70	<10	0.40	0.14	<0.14		22.0	13.0	0.56	0.26	3.00															
09/18/79	210		1100			20.8		30.16	<10	<10	0.40	0.13	<0.14				0.79	0.43	1.70															
09/18/79	230		1230			20.5		31.42	10	<10	0.60	0.36	1.20		11.0	11.0	0.86	0.82	2.10															
09/18/79	240		955			21.0		30.11	10	<10	3.60	0.59	3.00				1.00	0.69	1.90															
09/18/79	250		1000			21.0		30.39	<10	<10	3.90	0.41	2.70		14.0	14.0	0.93	0.78	2.00															
09/18/79	260		1040			20.5		31.46	<10	<10	1.90	0.24	0.30		18.0	18.0	1.50	1.10	2.00															
09/18/79	270		1030			21.1		31.24	<10	<10	1.90	0.26	1.10		30.0	21.0	1.50	1.10	2.10															
09/18/79	280		927			21.2		28.04	10	<10	1.40	0.26	0.46		24.0	18.0	0.75	0.50	1.60															
09/18/79	290		1110			20.8		30.11	20	20	0.40	0.14	<0.14		28.0	21.0	0.58	0.41	1.40															
09/18/79	300		1315			21.3		29.18	400	10	1.30	0.20	0.14		28.0	11.0	0.66	0.27	1.80															
09/25/79	210		1220		6.0	16.6		29.89	30	<10	1.80	0.24	0.79		15.0	15.0	0.77	0.50	1.60															
09/25/79	220		1345		10.0	18.4		31.64	<10	<10	0.30	0.10	<0.14		15.0	15.0	0.95	0.77	1.60															
09/25/79	230		1304		9.0	18.4		31.58	<10	<10	0.20	0.09	<0.14		8.0	8.0	0.95	0.65	1.30															
09/25/79	240		1110		7.0	17.1		27.76			9.20	0.80	9.90		22.0	22.0	1.10	0.71	1.40															
09/25/79	250		1120		6.5	17.0		28.79	70	<10	7.50	0.65	8.60		16.0	16.0	1.10	0.73	1.70															
09/25/79	260		1205		6.0	16.6		31.18	<10	<10	2.40	0.26	0.32		12.0	12.0	1.30	0.99	1.90															
09/25/79	270		1150		5.0	16.8		30.20	<10	<10	0.40	0.18	0.15		12.0		0.81	0.44	1.60															
09/25/79	280		1100		4.5	16.7		28.53			4.30	0.37	3.20		19.0		0.63	0.44	1.70															
09/25/79	290		1240		5.0	17.0		30.72	<10	<10	0.50	0.24	0.46		22.0	13.0	0.66	0.74	1.60															
09/25/79	300		1410		6.0	16.8		27.82	10	<10	1.30	0.17	0.23		19.0	17.0	0.86	0.59	1.50															
10/30/79	210		1240			9.7		29.88	<10	<10	3.90	0.73	5.40		27.0	11.0	0.38	0.39	0.72															
10/30/79	230		1316			12.2		31.99	<10	<10	3.50	0.39	7.90		11.0	11.0	1.50	1.30	1.60															
10/30/79	240		1120			10.5		27.89	<10	<10	16.00	1.20	17.00		41.0	20.0	0.67	0.76	1.00															
10/30/79	250		1158			10.1		29.08	<10	<10	14.00	0.92	11.00		49.0	21.0	0.67	0.79	1.10															
10/30/79	260		1220			10.1		31.48	10	<10	5.30	0.52	1.90		26.0	26.0	0.93	0.84	1.20															
10/30/79	270		1207			10.3		30.36	<10	<10	7.90	0.59	5.20		41.0	19.0	0.76	0.67	0.97															
10/30/79	280		1104			10.3		27.21	<10	<10	9.40	1.20	9.10		57.0	22.0	0.40	0.28	0.76															
10/30/79	290		1250			9.7		29.32	<10		5.70	0.82	5.90		41.0	25.0	0.46	0.43	0.93															
10/30/79	300		1400			10.3			<10	<10	3.80	1.00	5.90		37.0	23.0	0.42	0.28	0.72															
11/15/79	210		1125			8.1		28.53	40	10	5.80	0.66	4.80		31.0	24.0	0.54	0.41	0.82															
11/15/79	230		1242			9.0		28.20	10	<10	7.00	0.74	5.80		35.0			0.68	1.10															
11/15/79	240		1043			8.9		26.32	30	20	57.00	0.87	18.00		35.0		0.72	0.75	1.10															
11/15/79	250		1050			8.9		28.87	80	<10	48.00	0.59	82.00		36.0	36.0	0.70	0.36	1.00															

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DATE	STAT	Loc.	TIME	DEPTH Ft.	SECCHI Ft.	TEMP ºC	DO mg/l	SALINITY t.	TOT. COLI. MPN/100ml	FEC. COLI.	NH3_N (	NO2_N	NO3_N	COMB. NO_N ug. atoms / liter	TKN	TDKN	TDPO4_P	OPO4_P	TPO4_P	SI_O3)	TOC (	DOC	TC	TSS mg./liter	VSS	BOD5	BOD20)	Aureo Cells /ml.	Small Cells /ml.	Chlor Total	Chlor Filt.	COND	FLOW24	pH
11/15/79	260		1109			8.4		30.67	10	<10	6.10	0.36	2.00		22.0	22.0	0.89	0.95	1.30															
11/15/79	270		1100			8.5		29.55			10.00	0.55	6.80		28.0	26.0	0.74	0.69	1.20															
11/15/79	280		1033			8.8			<10	<10	17.00	1.00	9.10		44.0		0.66	0.48	1.10															
11/15/79	290		1135			7.8		28.60	50	10	6.70	0.64	4.90		34.0	30.0	0.60	0.44	0.94															
11/15/79	300		1310			8.9		26.86	<10	<10	5.70	0.73	5.20		35.0			0.39	0.99															
11/26/79	210		1250			13.5		30.11	60	30	1.60	0.56	3.20		33.0			0.47	1.10															
11/26/79	240		1115			12.5		28.38	20	20	6.20	0.88	13.00		44.0			0.67	3.00															
11/26/79	250		1120			12.6		28.36	40	10	6.20	0.86	13.00		50.0			0.73	2.20															
11/26/79	260		1215			13.2		31.48	<10	<10	3.30	0.01	4.20		29.0			0.97	1.50															
11/26/79	270		1154			13.0		30.50	<10	<10	2.60	0.35	6.70		44.0			0.63	1.90															
11/27/79	230		1055			12.0		29.61	<10	<10	3.20	0.59	6.30		43.0	42.0	0.69	0.69	1.40															
11/27/79	280		1154			11.6		26.22	190	30	4.60	0.90	11.00		33.0	20.0	0.44	0.69	1.60															
11/27/79	290		1111			12.1		29.81	80	60	3.60	0.54	4.50		43.0	39.0	0.52	0.47	1.10															
11/27/79	300		1008			12.0		28.00	<10	<10	2.50	0.61	5.10		46.0	36.0	0.40	0.51	1.00															
12/10/79	210		1250			3.6		30.30			1.30	0.58	5.50		21.0		0.38	0.57	1.00															
12/10/79	250		1105								5.40	0.64	12.00		28.0		1.10	0.67	1.20															
12/10/79	260		1155			4.1		32.19			3.10	0.48	6.60		14.0		0.78	1.10	1.50															
12/10/79	270		1128			4.1		31.27			3.60	0.55	8.30		29.0			0.78	1.20															
12/10/79	280		1350			3.8		26.84			0.90	0.71	6.60		34.0	28.0	0.50	0.61	1.20															
12/10/79	290		1303			5.0					1.60	0.47	6.20		24.0	8.0	0.92	0.97	1.50															
12/11/79	230		1247			8.9					2.80	0.36	8.80		34.0	23.0	1.30	1.50	2.30															
12/11/79	240		1135			-0.3					6.30	0.57	16.00		17.0	7.0	0.45	0.69	1.00															
12/11/79	300		1214			4.9		29.22			1.50	0.60	5.40		24.0	24.0	0.94	0.61	1.30															
12/19/79	210		1340			-0.4		32.15			1.00	0.45	3.20		<7.0	<7.0	0.91	0.88	1.40															
12/19/79	250		1200			0.4		31.25			1.60	0.54	6.50		10.0	<7.0	0.53	0.69	1.30															
12/19/79	260		1254			3.1					2.00	0.44	4.60		<7.0	<7.0	1.10	0.57	1.20															
12/19/79	270		1230			0.3					3.40	0.55	6.50		7.0	<7.0	0.60	0.68	1.10															
01/16/80	230		1130			5.3					0.70	0.20	2.40		36.0	37.0	0.59	1.10	1.70															
01/16/80	250		1440			3.2					2.90	0.45	11.00				0.17	0.53	1.30															
01/23/80	250		1350			2.7					2.30	0.36	6.00		19.0	16.0	0.20		1.10															
01/30/80	250		1320			0.7					0.10	0.26	1.60		<7.0	<7.0	0.22	0.55	1.40															
02/14/80	230		1055			1.1					0.50	0.20	0.90		19.0	12.0	0.50	0.06	1.50															
02/14/80	250		915			0.4					0.30	0.10	0.40		44.0	12.0	0.20	0.06	2.10															
02/14/80	280		1210			1.4					0.50	0.30	2.60		38.0	16.0	0.20	0.05	1.20															
02/14/80	290		1025			0.4					0.60	0.20	0.40		38.0	16.0	0.30	0.08	1.60															
03/19/80	230		1150			4.1					0.40	0.14	0.13		36.0	<7.0	0.60	0.70	1.50															
03/19/80	250		1111			5.4					4.00		0.25		43.0	21.0	0.35	0.60	1.30															
03/19/80	280		1240			4.8					0.60	0.13	0.14		33.0	14.0	0.20	0.70	1.20															
03/19/80	290		1125			4.8					0.60	0.12	0.20		21.0	14.0	0.35	0.60	1.10															
06/04/80	210		1205			21.5		29.24	20	10	1.40	0.14	0.21		64.0	57.0	0.71	0.84	1.58															
06/04/80	240		1032			21.8		26.58	11000	430	2.30	0.64	10.18		64.0	78.0	0.84	0.81	1.62															
06/04/80	250		1052			21.5		28.82	2400	230	0.90	0.14	0.42		64.0	43.0	0.61	0.84	1.49															
06/04/80	260		1142			19.5		30.66	30	10	2.10	0.14	0.64		50.0	43.0	1.23	1.03	2.07															
06/04/80	270		1120			21.1		29.32	4300	190	1.10	0.14	0.36		50.0	29.0	0.45	0.97	1.36															
06/04/80	280		1410			21.7		27.13	<10	<10	0.80	0.14	0.14		71.0	29.0	0.74	0.52	1.94															
06/04/80	290		1325			20.0		29.25	20	10	1.10	0.14	0.14		136.0	43.0	0.45	0.42	1.58															
06/04/80	300		1410					28.14	<100	<10	0.40	0.07	<0.14		21.0	21.0	0.65	0.52	1.20															
06/18/80	210		1325					29.58	4200	<10	4.10	0.14	0.79		86.0	100.0	1.62	0.58	1.84															
06/18/80	220		1330			15.5		32.25	10		0.60	0.07	<0.14		29.0	7.0	0.81	0.29	0.84															
[illegible]0	230		[illegible]315			14.9		[illegible]2.03	[illegible]		[illegible]	0.07	[illegible]		[illegible].0	<7[illegible]	[illegible]06	[illegible]	[illegible].71															

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DATE	STAT	Loc.	TIME	DEPTH Ft.	SECCHI Ft.	TEMP °C	DO mg/l	SALINITY ‰	TOT. COLI. MPN/100ml	FEC. COLI. MPN/100ml	NH3_N (	NO2_N	NO3_N	COMB. NO_N ug. atoms / liter	TKN	TDKN	TDPO4_P	OPO4_P	TPO4_P	SI_O3)	TOC (	DOC	TC	TSS mg./liter	VSS	BOD5	BOD20)	Aureo Cells /ml.	Small Cells /ml.	Chlor Total	Chlor Filt.	COND	FLOW24	pH
06/18/80	240		1135					28.92	<10	<10	2.10	0.14	0.86		100.0	100.0	0.90	0.74	2.33															
06/18/80	250		1145					29.49	<10	<10	1.40	0.21	0.57		64.0	71.0	2.71	0.68	2.74															
06/18/80	260		1234					31.75	20	<10	2.60	0.14	0.29		64.0	57.0	2.00	0.65	1.52															
06/18/80	270		1215					30.72	30	<10	0.80	0.14	<0.14		39.0	29.0	1.39	0.42	2.13															
06/18/80	280		1430					27.90	80	<10	1.40	0.14	0.14		57.0	57.0	1.26	0.36	2.29															
06/18/80	290		1335					30.10	190	<10	1.90	0.14	0.29		64.0	57.0	1.39	0.52	1.62															
06/18/80	300		1240			20.2		28.14	1900		1.40	0.14	0.14		43.0	29.0	0.94	0.26	1.52															
02/17/81	210		1220		5.0	4.7		29.02	<3	<3	2.10	0.29	1.50		36.0	21.0	0.52	0.61	0.80															
02/17/81	230		1305		4.0	2.3		32.84	<3	<3	1.60	0.21	2.00		64.0	43.0	0.58	0.78	1.50															
02/17/81	240		1025		5.0	5.4		29.64	430	30	8.90	0.43	5.60		57.0	29.0	0.19	0.55	1.10															
02/17/81	250		1040		5.5	4.1		28.84	21	<3	20.30	0.43	7.90		57.0	50.0	0.10	0.45	0.80															
02/17/81	260		1125		7.0	4.3		32.59	4	4	3.50	0.29	0.90				0.52	0.65	1.60															
02/17/81	270		1107		6.0	4.0		30.48	43	15	3.70	0.36	4.10		57.0	29.0	0.19	0.45	0.90															
02/17/81	290		1235		5.0	4.1		30.45	<3	<3	1.40	0.29	1.40		43.0	35.0	0.29	0.71	1.60															
03/09/81	210		1125			3.8		29.49	23	4	1.10	0.21	2.00		36.0	14.0	0.30	0.50	1.00															
03/09/81	220		1230			3.8		32.50	<3	<3	0.70	0.14	0.40		43.0	14.0	0.30	0.50	0.70															
03/09/81	230		1220			4.0		30.70	<3	<3	1.00	0.21	0.60		29.0	7.0	0.40	0.40	0.50															
03/09/81	240		1315			4.2		30.50	43	23	2.40	0.21	2.70		14.0	14.0	0.30	0.40	0.70															
03/09/81	250		1034			4.5		29.97	43	43	3.30	0.21	4.00		14.0	14.0	0.30	0.30	0.70															
03/09/81	260		1103			3.5		32.30	7	4	0.50	0.14	<0.10		21.0	21.0	0.40	0.50	1.10															
03/09/81	270		1050			4.3		31.49	43	43	0.40	0.14	0.20		14.0	14.0	0.20	0.30	0.70															
03/09/81	280		1302			4.2		27.82	11	7	1.80	0.29	4.30		29.0	14.0	0.40	0.40	0.40															
03/09/81	290		1135			3.5		30.21	9	4	1.20	0.21	1.60		29.0	21.0	0.10	0.50	1.20															
03/09/81	300		1100			3.4		29.00	<3	<3	0.60	0.21	0.50		21.0	<7.0	0.10	0.50	1.00															
04/01/81	210		1245			12.2		31.25	4	<3	1.30	0.14	0.14		64.0			0.26	0.71															
04/01/81	240		1022			11.3		30.99	240	4	3.60	0.21	2.60		29.0			0.29	0.97															
04/01/81	250		1059			11.4		31.06	4	4	4.50	0.21	2.20		57.0			0.45	0.79															
04/01/81	260		1143			10.7		32.55	<3	<3	0.90	0.14	0.14		21.0			0.29	1.00															
04/01/81	270		1123			11.2		31.49	15	9	1.80	0.14	0.29		25.0			0.23	1.00															
04/01/81	300		1141			9.8		17.58	4	4	1.10	0.14	0.14		36.0	21.0	0.13	0.58	0.78															
04/08/81	210		1245			10.8		27.65			0.60	0.14	0.57					0.26																
04/08/81	220		1145			7.2		32.55			1.40	0.14	0.82					0.39																
04/08/81	230		1120			6.9		32.56			2.10	0.14	1.20		43.0	14.0	1.50	0.36	1.70															
04/08/81	240		1450			11.0		30.30			4.90	0.29	3.10					0.23																
04/08/81	250		1430		4.0	10.0		29.24							36.0	14.0	0.30	0.23	1.40															
04/08/81	260		1355			10.3		32.22			1.30	0.14	0.43		29.0	21.0	0.30	0.39	0.80															
04/08/81	270		1410		4.0	10.1		32.20			0.90	0.14	0.29					0.32																
04/08/81	280		1009		4.0	10.0		29.49			1.20	0.14	0.64		36.0	50.0	0.40	0.90	2.10															
04/08/81	290		1225		4.0	9.6		31.28			2.10	0.14	1.60					0.19																
04/08/81	300		957		5.0	9.2		30.05	<3	<3	0.40	0.07	0.14					0.16																
04/22/81	210		1305		5.0	9.8					0.90	0.14	0.21		64.0	7.0	0.60	0.29	1.70															
04/22/81	240		1112		6.0	10.8		30.69			3.30	0.21	4.30		79.0	64.0	0.70	0.26	1.40															
04/22/81	250		1127		6.0	9.7		31.42			1.10	0.14	0.71		57.0	29.0	0.30	0.19	0.80															
04/22/81	260		1216		8.0	8.6		32.98			1.40	0.21	0.75		36.0	14.0	0.40	0.57	0.80															
04/22/81	270		1200		5.0	9.3		32.52			1.10	0.14	0.21		25.0	17.0	0.60	0.32	1.13															
04/22/81	300		1140		8.0	9.0		31.04			0.40	0.14	0.07		29.0	14.0	0.30	0.23	0.90															
05/06/81	210		1155		8.0	16.3		31.16	9	15	0.40	0.14	<0.14		29.0	29.0	1.03	0.26	2.29															
05/06/81	240		1230		5.0	17.3			23	4	1.90	0.32	3.21		36.0	14.0	0.45	0.19	2.26															
05/06/81	250		1015	5.0	5.0	17.0		30.42	9	<3	0.50	0.21	1.86		29.0	7.0	0.42	0.26	1.36															
05/06/81	260		1105		8.0	15.0		32.72	<3	<3	0.40	0.14	0.14		29.0	7.0	0.48	0.23	2.33															

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DATE	STAT	Loc.	TIME	DEPTH Ft.	SECCHI Ft.	TEMP °C	DO mg/l	SALINITY ‰	TOT. COLI. MPN/100ml	FEC. COLI. MPN/100ml	NH3 N (	NO2 N	NO3 N	COMB. NO_N ug. atoms / liter	TKN	TOKN	TDPO4 P	OPO4 P	TPO4 P	SI O3)	TOC (	DOC	TC	TSS mg/liter	VSS	BOD5	BOD20)	Aureo Cells /ml.	Small Cells /ml.	Chlor Total	Chlor Filt.	COND	FLOW24	pH
05/06/81	270		1045	7.0	6.0	17.4		31.75	4	<3	1.10	0.14	0.39		18.0	7.0	1.07	0.45	1.11															
05/06/81	300		1300		8.0	14.8		30.87	<3	<3	0.40	0.14	<0.14		7.0	7.0	0.65	0.26	0.84															
07/06/81	210		1125		6.0	24.2		29.90			4.70	0.14	0.86		36.0	21.0	0.61	0.36	1.80															
07/06/81	220		1225		14.0	20.4		31.31			<0.10	0.07	<0.14					0.68																
07/06/81	230		1215		6.5	20.0		31.31			0.60	0.14	0.21		64.0	21.0	0.71	0.55	1.30															
07/06/81	240		928		5.0	24.4		25.64			16.60	0.64	5.78		64.0	50.0	0.97	0.36	2.40															
07/06/81	250		940		5.0	24.3		27.73			8.00	0.36	2.07		36.0	36.0	0.61	0.71	1.78															
07/06/81	260		1026		5.0	24.3		27.73			8.00	0.14	0.50		29.0	21.0	1.13	0.94	2.00															
07/06/81	270		1007			24.6		28.41			4.10	0.21	0.93		57.0	29.0	1.16	0.68	2.30															
07/06/81	280		1224		4.0	25.6		28.84			0.60	0.14	0.36		21.0	39.0	0.36	0.26	1.80															
07/06/81	290		1142		5.0	23.7		29.71			3.10	0.14	0.21		43.0	29.0	0.48	0.29	1.10															
07/06/81	300		0		3.5	24.1		30.50			1.10	0.14	0.36		29.0	21.0	0.10	0.32	0.80															
08/12/81	210		0								2.40	0.14	0.61		50.0	36.0	1.94	0.61	2.32															
08/12/81	220		1100		21.0	22.0		31.87			0.60	0.07	0.50		7.0	21.0	0.45	0.48	0.58															
08/12/81	230		1045		13.0	21.2		31.95			1.30	0.14	0.43		7.0	21.0	1.06	0.65	0.84															
08/12/81	240		0								2.90	0.57	3.07		50.0	43.0	1.81	1.07	2.68															
08/12/81	250		0								7.60	0.64	1.64		43.0	21.0	1.49	1.16	2.39															
08/12/81	260		0								2.00	0.21	0.43		36.0	21.0	1.97	1.24	3.04															
08/12/81	270		0								3.70	0.36	1.14		36.0	21.0	1.68	1.23	2.26															
08/12/81	280		0								0.80	0.14	0.14		50.0	21.0	0.74	0.55	1.87															
08/12/81	290		0								3.00	0.21	0.57		36.0	50.0	1.62	1.32	3.07															
08/12/81	300		1130		5.0	25.0		31.08			2.30	0.14	0.43		36.0	28.0	1.06	0.65	1.87															
09/14/81	210		1143		5.0			29.90			0.20	0.14	<0.14		57.0	50.0	1.19	0.16	2.00															
09/14/81	220		1108		9.0			31.97			0.10	0.14	<0.14		21.0	36.0	1.00	0.84	1.39															
09/14/81	230		1059		8.0			31.55			0.10	0.11	<0.14		14.0	7.0	0.71	0.65	1.87															
09/14/81	240		1230		4.0			30.34			0.30	0.14	<0.14		14.0	14.0	0.71	0.45	1.52															
09/14/81	250		1225		4.5			30.65			0.20	0.14	<0.14		21.0	14.0	0.84	0.55	1.68															
09/14/81	260		1200		4.5			31.71			0.20	0.14	<0.14		28.0	14.0	0.84	0.84	2.29															
09/14/81	270		1213		4.5			31.23			0.20	0.14	<0.14					0.58																
09/14/81	280		1247		5.0			27.88			0.30	0.14	0.14					0.23																
09/14/81	290		1134		6.0			30.29			0.30	0.14	<0.14					0.35																
09/14/81	300		1018		5.0			29.76			0.40	0.14	<0.14		43.0	36.0	0.58	0.23	1.55															
09/28/81	210		1245			18.8		31.27			0.90	0.21	<0.14					0.19																
09/28/81	230		1200			18.7		31.98			0.30	0.07	<0.14		7.0	21.0	1.03	0.71	1.16															
09/28/81	240		1032			18.9		30.58			2.60	0.57	2.57		21.0	14.0	0.45	0.38	0.83															
09/28/81	250		1335			19.0		31.45			2.00	0.35	0.92					0.38																
09/28/81	260		1315			18.5		31.81			1.50	0.21	0.21		21.0	21.0	0.32	0.58	1.55															
09/28/81	270		1340			18.2		30.35			4.10	0.50	2.71		21.0	14.0	0.42	0.22	0.93															
09/28/81	280		1058			18.0		29.02			0.60	0.14	<0.14		50.0	29.0	0.45	0.17	4.26															
09/28/81	290		1230			18.9		30.43			0.50	0.14	<0.14					0.16																
09/28/81	300		1045			18.1					0.70	0.21	0.30		21.0	14.0	0.77	0.61	1.00															
02/23/82	210		1217	5.0	0.6	3.4		27.88			1.60	0.29	4.60					0.13																
02/23/82	230		1026			1.7		31.54			1.10	0.14	3.40		21.0	14.0	1.10	0.78	0.79															
02/23/82	240		1015	5.0		1.8		26.67			8.80	0.43	14.90					0.16																
02/23/82	250		1030	6.0		1.9		28.80			3.80	0.29	5.80		43.0	36.0	0.32	0.19	1.00															
02/23/82	260		1130	15.0		2.6		30.21			0.60	0.14	0.90					0.16																
02/23/82	270		1110	7.0		1.7		30.13			0.70	0.14	2.60		36.0	14.0	0.29	0.16	0.84															
02/23/82	280		1309	8.0		3.1		26.33			4.90	0.50	15.00		43.0	21.0	0.19	0.13	0.97															
02/23/82	2[illegible]0		1232	15.0		2.[illegible]		28.04			[illegible]	0.3[illegible]	[illegible].30					[illegible]																
[illegible]/82	3[illegible]		1002	[illegible].0		1.[illegible]		27.32			[illegible]	0.3[illegible]	[illegible].40					0.74																

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DATE	STAT	Loc.	TIME	DEPTH Ft.	SECCHI Ft.	TEMP °C	DO mg/l	SALINITY ‰	TOT. COLI. MPN/100ml	FEC. COLI.	NH3_N (	NO2_N	NO3_N	COMB. NO_N ug. atoms / liter	TKN	TDKN	TDPO4_P	OPO4_P	TPO4_P	SI_O3)	TOC (	DOC	TC	TSS mg./liter	VSS	BOD5	BOD20)	Aureo Cells /ml.	Small Cells /ml.	Chlor Total	Chlor Filt.	COND	FLOW24	pH
03/16/82	210		1147		4.0			29.81			1.00	0.14	0.50		29.0	14.0	0.39	0.10	1.15															
03/16/82	230		1310		8.0			31.60			0.70	0.07	<0.14		21.0	14.0	0.39	0.29	0.84															
03/16/82	240		1032					28.07			6.00	0.21	5.10		43.0	29.0	0.26	0.10	1.00															
03/16/82	250		1040	4.0	4.0			28.48			6.40	0.21	5.90		29.0	29.0	0.52	0.10	0.61															
03/16/82	260		1106		6.5						0.60	0.07	<0.14					0.13																
03/16/82	270		1054	4.0	4.0			30.06			1.90	0.14	0.40		29.0	14.0	0.26	0.10	0.74															
03/16/82	280		1001		7.0			26.55			2.00	0.36	4.10					0.13																
03/16/82	300		1340		4.0						1.20	0.21	0.90					0.10																
03/30/82	210		235			5.4		29.33			0.10	0.29	2.10					0.13																
03/30/82	240		924			6.2					6.60	0.29	4.10					0.10																
03/30/82	250		935			5.5		30.15			2.90	0.14	1.20		21.0	14.0	0.39	0.16	1.39															
03/30/82	260		1020			4.4		31.52			0.30	0.10	<0.14		<7.0	<7.0	0.39	0.29	1.36															
03/30/82	270		1001			5.6		30.85			0.50	0.14	0.14					0.13																
03/30/82	280		1211			6.0		27.41			1.40	0.36	4.80		14.0	14.0	0.23	0.10	1.10															
03/30/82	290		1250			5.5		30.13			0.90	0.14	0.90		21.0	<7.0	0.10	0.13	0.90															
03/30/82	300		1211			5.9					0.60	0.29	2.70		21.0	14.0	0.19	0.10	1.03															
05/11/82	210		1034			15.1		31.18			0.80	0.14	<0.14		14.0	29.0	1.16	0.45	1.62															
05/11/82	230		1150			11.5		28.27			0.90	0.07	<0.14		14.0	7.0	0.45	0.13	0.58															
05/11/82	240		1225			16.6		28.44			1.10	0.29	3.93		29.0	14.0	0.55	0.13	1.20															
05/11/82	250		944			16.0		31.24			1.80	0.29	3.60		21.0	14.0	0.65	0.13	0.81															
05/11/82	260		1002			14.5		31.28			0.90	0.14	<0.14					0.65																
05/11/82	270		952			15.5		29.19			0.20	0.07	<0.14		14.0	29.0	0.61	0.13	0.71															
05/11/82	280		1214			15.8		28.48			0.30	0.07	<0.14		21.0	7.0	0.42	0.13	1.10															
05/11/82	290		1045			14.9		30.36			0.40	0.14	<0.14					0.16																
07/14/82	210		1250		5.0	26.4		29.31			0.30	0.14	<0.14					0.78																
07/14/82	220		1125		18.0	23.4		30.38			<0.10	0.07	<0.14					0.29																
07/14/82	230		1117		10.0	25.2		28.36			2.80	0.14	0.14		7.0	21.0	1.70	0.81	1.80															
07/14/82	235		1140		12.0	23.2		30.40			<0.10	0.07	<0.14					0.36																
07/14/82	240		1315		4.5	27.4		27.71			0.40	0.14	<0.14		21.0	14.0	1.10	0.13	3.50															
07/14/82	250		1303		4.5	27.1		28.25			0.50	0.14	<0.14		21.0	7.0	1.74	0.42	3.90															
07/14/82	280		1330		3.0	26.6		26.46			0.40	0.14	<0.14					0.19																
07/14/82	290		1242		4.5	26.3		28.18			0.30	0.14	<0.14					0.42																
07/14/82	300		1045		2.0	26.1		25.83			0.30	0.14	<0.14		29.0	21.0	1.00	0.16	2.80															
07/28/82	210		1120					30.41			0.50	0.14	0.43		7.0	7.0	8.40	0.61	12.30															
07/28/82	240		945					23.27			4.80	0.50	1.14		14.0	14.0	19.10	1.10	32.30															
07/28/82	250		930								4.90	0.43	1.00		29.0	29.0	22.60	1.80	23.30															
07/28/82	260		1020					29.99			2.00	0.14	0.57		10.0	32.0	7.80	0.71	11.60															
07/28/82	270		1000					28.27			3.10	2.10	8.60		7.0	14.0	14.20	1.10	16.80															
07/28/82	280		1215					29.69			5.40	0.50	0.90		14.0	7.0	18.70	1.90	20.70															
07/28/82	290		1150					29.72			4.30	2.10	0.57		14.0	14.0	16.20	3.90	16.80															
09/29/82	210		1056			19.6		30.56			0.70	0.21	0.14					0.32																
09/29/82	240		1016			19.7		28.86			3.10	0.78	5.64					0.16																
09/29/82	250		1021			19.9		29.83			3.00	0.64	2.92					0.19																
09/29/82	260		1037			19.4		31.37			1.40	0.28	0.35					0.67																
09/29/82	270		1030			19.9		30.15			1.50	0.49	1.99					0.19																
09/29/82	280		1007			19.6		29.12			0.20	0.14	<0.14					0.12																
09/29/82	290		1105			19.6		30.31			0.30	0.14	0.14					0.22																
10/27/82	210		1242			10.1		29.99			0.60	0.21	0.43		43.0	36.0	1.60	0.29	2.20															
10/27/82	240		1023					28.35			7.70	0.71	10.10		43.0	57.0	1.13	0.29	1.20															
10/27/82	250		1035			10.5		27.15			6.40	0.64	5.90		50.0	29.0	1.36		1.23															

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DATE	STAT	Loc.	TIME	DEPTH Ft.	SECCHI Ft.	TEMP °C	DO mg/l	SALINITY ‰	TOT. COLI. MPN/100ml	FEC. COLI. MPN/100ml	NH3 N (	NO2 N	NO3 N	COMB. NO_N ug. atoms / liter	TKN	TDKN	TDPO4_P	OPO4_P	TPO4_P)	SI_O3	TOC (	DOC	TC	TSS mg./liter	VSS	BOD5	BOD20)	Aureo Cells /ml.	Small Cells /ml.	Chlor Total	Chlor Filt.	COND	FLOW24	pH
10/27/82	260		1050			10.1		31.16			1.40	0.21	0.21		36.0	29.0	1.45	0.39	1.30															
10/27/82	270		1042			10.0		30.45			0.60	0.14	<0.14		43.0	36.0	1.13	0.29	1.00															
10/27/82	280		1402					28.43			0.60	0.14	<0.14		57.0	43.0	2.10	0.32	2.10															
10/27/82	290		1257			10.5		30.23			1.00	0.21	0.14		36.0	21.0	1.49	0.31	1.65															
11/15/82	210		1229			9.4					3.10	0.36	2.43		7.0	7.0	0.55	0.42	0.81															
11/15/82	240		1035			9.1					24.00	0.86	10.30		20.0		0.90	0.20	0.97															
11/15/82	250		1048			9.3					6.70	0.86	6.90		21.0	29.0	0.87	0.42	0.61															
11/15/82	260		1137			10.1					4.60	0.70	5.60		14.0	14.0	1.03	0.81	1.42															
11/15/82	270		1120			9.5					5.40	0.79	4.10		14.0	7.0	0.94	0.78	1.32															
11/15/82	280		1405			9.2					6.10	0.71	8.10		29.0	14.0	0.87	0.29	1.81															
11/15/82	290		1243			9.1					2.90	0.29	2.30		64.0	36.0	1.10	0.39	1.39															
07/12/83	210		1326			23.7			<30	<30	1.30	0.14	0.14					0.58																
07/12/83	240		1245			24.2			<30	<30	1.10	0.21	0.86					1.55																
07/12/83	250		1253			24.2			<30	<30	1.20	0.21	0.29					1.29																
07/12/83	260		1315			23.6			<30	<30	0.80	0.14	0.27					0.90																
07/12/83	270		1305			24.4			<30	<30	0.50	0.14	0.14					1.20																
07/12/83	280		1210			24.2			<30	<30	0.50	0.14	0.29					0.16																
07/12/83	290		1335			22.9			<30	<30	0.40	0.14	<0.14					0.39																
07/12/83	300		1405			23.2			<30	<30	0.40	0.21	<0.14					0.29																
08/15/83	300		1214			20.7		26.16	30	30	0.40	0.14	<0.14		43.0	21.0	0.55	0.13	1.55															
06/13/84	210		1300			25.3		27.99	<30	<30	0.10	0.07	<0.14		43.0	50.0	0.78	0.23	2.33															
06/13/84	240		1154			25.9		27.05	40	<30	0.30	0.07	<0.14		57.0	21.0	1.07	0.06	2.13															
06/13/84	250		1218			25.7		27.73	<30	<30	0.20	0.07	<0.14		50.0	14.0	0.71	0.16	1.81															
06/13/84	260		1240			23.6		29.22	<30	<30	<0.10	0.07	0.14		29.0	7.0	1.32	0.32	4.23															
06/13/84	270		1231			25.3		27.85	<30	<30	0.10	0.07	<0.14		43.0	7.0	1.00	0.13	2.26															
06/13/84	280		1134			25.7		24.00	<30	<30	0.20	0.07	<0.14		43.0	14.0	0.78	0.10	4.33															
06/19/84	210		1122			21.5		27.19	70	40	0.40	0.14	<0.14		36.0	43.0	0.74	0.29	2.23															
06/19/84	230		1258			17.1		27.53	<30	<30	<0.10	0.07	<0.14		14.0	<7.0	0.19	0.23	0.68															
06/19/84	240		947			21.9		25.47	90	40	9.40	0.93	9.28		36.0	21.0	0.61	0.39	2.00															
06/19/84	250		1028			21.8		25.39	930	150	26.40	0.86	9.78		43.0	36.0	0.74	0.19	1.52															
06/19/84	260		1050			20.4		29.44	<30	<30	0.60	0.14	0.39		14.0	14.0	1.84	0.52	3.29															
06/19/84	270		1042			21.6		28.80			0.50	0.14	0.36		7.0	7.0	1.03	0.19	1.84															
06/19/84	280		930			21.7		24.06	<30	<30	0.30	0.14	0.14		29.0	14.0	0.61	0.10	3.94															
06/19/84	290		1134			21.2		26.83	40	<30	0.60	0.14	0.43		57.0	43.0	1.13	0.19	1.71															
06/19/84	300		1239			21.8		25.50	40	<30	0.40	0.14	<0.14		29.0	7.0	0.45	0.06	1.91															
07/03/84	300		1205			23.7		25.07	<30	<30	0.40	0.14	0.14		64.0	36.0		0.13																
08/08/84	210		1109			26.4		27.84	<30	<30	0.40	0.14	<0.14		14.0	14.0	1.07	0.34	2.03															
08/08/84	220		1146			20.4		32.36	<30	<30	<0.10	0.07	<0.14		<7.0	<7.0	0.39	0.26	0.61															
08/08/84	230		1137			22.2			<30	<30	0.10	0.07	<0.14		7.0	<7.0	0.39	0.26	5.50															
08/08/84	240		1017			27.0		28.47	430	430	9.10	0.86	4.57		29.0	21.0	2.84	1.26	3.07															
08/08/84	250		1021			26.7		28.89	230	40	6.00	0.50	2.78		14.0	21.0	2.65	1.49	3.04															
08/08/84	260		1045			25.5		29.95	<30	<30	0.60	0.14	0.14		14.0	7.0	2.94	1.16	3.08															
08/08/84	270		1037			26.5		28.54	430	230	4.70	0.50	2.57		14.0	21.0	1.97	1.42	1.94															
08/08/84	280		1002			26.8		24.90	430	90	0.50	0.21	0.14		29.0	29.0	0.90	0.16	2.33															
08/08/84	290		1117			26.3		27.43	40	<30	0.40	0.14	<0.14		29.0	21.0	1.13	0.36	2.45															
08/08/84	300		1230			26.6		25.28	<30	<30	0.30	0.14	<0.14		36.0	29.0	1.10	0.13	2.49															
08/20/84	210		1099			24.2		26.58	<30	<30	0.50	0.14	0.21		29.0	14.0	1.10	0.24	2.30															
08/20/84	230		945			24.5			<30	<30	0.60	0.14	0.14		29.0	14.0	0.78	0.23	2.86															
08/20/84	240		1216			25.5		21.89	<30	<30	7.30	0.43	4.50		29.0	29.0	0.97	0.16	2.36															
[illegible]	250		[illegible]			25.1		[illegible]	[illegible]	<30	[illegible]	0.29	[illegible]		[illegible]	29.0	[illegible]	[illegible]	1.45															

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DATE	STAT	Loc.	TIME	DEPTH	SECCHI	TEMP	DO	SALINITY	TOT. COLI.	FEC. COLI.	NH3_N	NO2 N	NO3 N	COMB. NO_N	TKN	TDKN	TDPO4_P	OPO4_P	TPO4_P	SI_O3	TOC	DOC	TC	TSS	VSS	BOD5	BOD20	Aureo Cells	Small Cells	Chlor	Chlor	COND	FLOW24	pH
				Ft.	Ft.	°C	mg/l	%.	MPN/100ml		(			ug. atoms / liter						)	(			mg./liter			)	/ml.	/ml.	Total	Filt.			
08/20/84	260		1135			24.4		29.54	<30	<30	2.40	0.14	<0.14		43.0	21.0	2.70	1.40	3.50															
08/20/84	270		1150			24.5		27.93	<30	<30	0.40	0.14	<0.14		29.0	21.0	1.30	0.36	3.10															
08/20/84	280		1237			25.1		24.90	<30	<30	1.10	0.07	0.14		51.0	29.0	0.84	0.13	2.70															
08/20/84	290		1042			24.1		27.30	40	<30	1.60	0.14	0.14		50.0	29.0	1.90	0.55	2.70															
08/20/84	300		900			24.1		23.99	40	<30	1.10	0.14	0.14		71.0	29.0	1.50	0.19	3.10															
09/25/84	210		1200			22.1		30.26	23	23	1.60	0.21	0.21		14.0	7.0	1.03	0.30	1.71															
09/25/84	230		1050			19.6		31.51	4	<3	1.10	0.21	0.21		7.0	<7.0	1.49	0.97	2.58															
09/25/84	240		1310			22.6		30.29	4	<3	4.30	0.43	1.60					0.87																
09/25/84	250		1245			22.2		30.31	9	4	0.70	0.36	1.20		14.0	7.0	1.36	0.90	2.29															
09/25/84	260		1220			22.3		31.31	23	23	1.80	0.21	0.14					1.23																
09/25/84	270		1235			22.0		30.74	23	23	0.30	0.14	0.36		14.0	14.0	1.68	1.16	2.33															
09/25/84	280		1322			22.4		27.91	<3	<3	2.50	0.50	3.00					0.29																
09/25/84	290		1145			21.0		29.88	4	<3	0.80	0.14	0.14		14.0	14.0	1.29	0.48	2.55															
09/25/84	300		1000			21.4		27.61	4	<3	1.10	0.14	<0.14		21.0	7.0	1.32	0.19	2.45															
10/09/84	210		1100			15.2		28.99	23	<3	0.40	0.29	0.86					0.11																
10/09/84	230		1000			16.0		31.31	<3	<3	1.80	0.21	0.36					0.84																
10/09/84	240		1045			15.5		29.76	23	4	4.30	0.57	3.57					0.45																
10/09/84	250		1137			15.6			9	4	2.30	0.36	1.57					0.55																
10/09/84	260		1120			15.8		31.35	9	<3	2.60	0.21	0.64					0.71																
10/09/84	270		1130			16.0		30.88	43	<3	2.80	0.36	1.57					0.71																
10/09/84	280		1230			15.1		27.67	23	<3	2.40	0.71	5.21					0.13																
10/09/84	290		11			15.5		29.72	23	9	0.90	0.21	1.07					0.32																
10/09/84	300		905			14.5		26.91	9	<3	0.20	0.14	<0.14					0.13																
11/21/84	210		1154			3.5		30.29	23	9	5.10	0.86	3.64					0.29																
11/21/84	240		1104			4.5		30.44	9	4	9.90	1.14	7.78					0.78																
11/21/84	250		1115			4.6		30.43	43	15	8.60	1.14	8.57					0.87																
11/21/84	260		1135			5.0		31.43	<3	<3	6.20	1.00	5.28					1.13																
11/21/84	270		1125			4.7		31.00	93	93	7.90	1.14	7.64					1.16																
11/21/84	280		1205			4.2		27.93	<3	<3	5.60	0.79	6.64					0.32																
11/27/84	300		1355			6.4		27.81	<3	<3	1.10	0.36	2.86		14.0			0.26	1.36															
12/05/84	210		1238			5.2			3	<3	0.40	0.21	0.57		7.0	7.0	0.39	0.06	1.10															
12/05/84	240		1122			5.6			240	43	3.00	0.64	7.14		21.0	7.0	0.36	0.06	1.00															
12/05/84	250		1139			5.9			93	23	4.40	0.64	7.43		7.0	14.0	0.36	0.06	0.81															
12/05/84	260		1222			5.7			9	9	3.70	0.64	2.78		<7.0	<7.0	0.84	0.39	1.20															
12/05/84	270		1207			5.6			240	93	4.90	0.72	6.00		7.0	7.0	0.42	0.16	1.10															
12/05/84	280		1055			5.4			43	23	1.40	0.50	4.43		14.0	<7.0	0.68	<0.06	1.55															
12/05/84	290		1250			5.1			93	43	0.60	0.14	0.18		<7.0	<7.0	0.39	<0.06	1.39															
05/06/85	300		1145			13.6		29.17	<3	<3	0.70	0.14	<0.71					0.16																
05/08/85	210		1035			14.1		31.39	15	9	0.70	0.14	0.71					0.16																
05/08/85	230		1145			10.2		32.22	<3	<3	2.10	0.14	0.71					0.45																
05/08/85	240		935			14.7		29.62	23	4	5.70	0.50	6.43		57.0	36.0	0.65	0.16	1.87															
05/08/85	250		940			14.3		30.87	<3	<3	5.00	0.43	3.57		50.0	29.0	0.65	0.23	1.84															
05/08/85	260		1015			13.4		31.88	<3	<3	2.10	0.21	1.42					0.39																
05/08/85	270		1000			13.4		31.51	7	<3	3.60	0.29	2.85		29.0	7.0	0.81	0.26	2.16															
05/08/85	280		920			14.5		28.50	43	4	0.70	0.14	0.71		64.0	21.0	0.71	0.16	2.81															
05/08/85	290		1045			14.1		30.53	7	7	1.40	0.14	0.71					0.13																
06/19/85	210		1125		3.0	21.4		30.20	43	23	0.70	0.14	1.43					0.26																
06/19/85	230		1040		4.5	15.6		31.71	9	<3	0.70	0.36	<0.71		14.0	7.0	0.74	0.45	2.13															
06/19/85	240		1225		3.0	22.5		28.85	43	9	0.70	0.21	0.71					0.32																
06/19/85	250		1210		3.5	22.2		29.49	23	<3	0.70	0.14	0.71		21.0	14.0	1.10	0.45	2.55															

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DATE	STAT	Loc.	TIME	DEPTH Ft.	SECCHI Ft.	TEMP °C	DO mg/l	SALINITY ‰	TOT. COLI. MPN/100ml	FEC. COLI.	NH3_N (	NO2_N	NO3_N	COMB. NO_N ug. atoms / liter	TKN	TDKN	TDPO4_P	OPO4_P	TPO4_P	SI_O3)	TOC (	DOC	IC	TSS mg./liter	VSS	BOD5	BOD20)	Aureo Cells /ml.	Small Cells /ml.	Chlor Total	Chlor Filt.	COND	FLOW24	pH
06/19/85	260		1150		3.5	20.8		30.85	43	43	1.40	0.21	0.71		21.0	14.0	1.16	0.71	2.45															
06/19/85	270		1200		4.5	21.8		29.79	150	4	0.70	0.21	0.71					0.52																
06/19/85	280		1235		2.0	22.2		28.05	23	4	0.70	0.21	0.71					0.19																
06/19/85	290		1100		3.0	20.0		30.32	23	23	<0.70	0.14	0.71					0.19																
06/19/85	300		955		1.5	20.5		28.96	9	<3	0.70	0.21	0.71		50.0	21.0	0.84	0.16	3.78															
08/13/85	230		1228		2.5	23.5		31.56	23	9	0.70	0.18	0.71		29.0			1.13	2.84															
08/13/85	300		1202		1.5	25.9		30.01	9	4	0.70	0.29	0.71		57.0			1.52	4.30															
09/03/85	210		1205		2.0	22.6		30.42	23	23	0.70	0.21	1.43		36.0			1.00	4.30															
09/03/85	220		1240		20.0	21.6		32.35	<3	<3	0.70	0.14	0.71		<7.7	<7.0		0.45	1.10															
09/03/85	230		1233		13.0	21.0		32.34	<3	<3	0.70	0.14	0.71		7.0			0.55	0.87															
09/03/85	240		1123		1.5	22.4		29.26	21	9	0.70	0.29	1.43		57.0			0.71	4.85															
09/03/85	250		1130		2.0	22.5		29.78	23		0.70	0.29	1.43		50.0			0.84	4.62															
09/03/85	260		1145		3.5	22.1		31.94	7	7	1.40	0.21	0.71		14.0			1.13	2.97															
09/03/85	270		1138		2.0	22.3		31.25	7	4	0.70	0.21	1.43		50.0			1.10	3.97															
09/03/85	280		1115		2.0	22.4		28.77	4	<3	0.70	0.29	1.43		57.0			0.58	4.04															
09/03/85	290		1214		2.0	22.5		30.60	15	15	0.70	0.29	1.43		21.0			0.90	3.94															
09/03/85	300		1322		2.0	22.6		29.60	23	9	10.00	0.29	1.43		64.0			0.74	4.23															
11/19/85	210		1138		3.0	10.2			23	9	7.10	0.50	3.57					0.40																
11/19/85	220		925		5.0	12.8			23	<3	6.40	0.71	4.28		14.0	7.0	1.03	1.20	1.55															
11/19/85	230		915		2.5	10.6			9	4	3.60	0.50	2.86		29.0	14.0	0.84	0.65	2.03															
11/19/85	240		1210		4.0	11.4			43	43	17.10	0.86	9.28					0.42																
11/19/85	250		1142		4.0	11.4			240	93	21.40	0.86	11.42		36.0	36.0	0.45	0.42	1.20															
11/19/85	260		1116		4.0	11.1			23	4	10.00	0.64	5.00		21.0	21.0	1.26	0.97	1.42															
11/19/85	270		1126		4.0	11.1			93	93	15.70	0.86	7.85		29.0	21.0	1.45	0.61	1.84															
11/19/85	280		1222		2.0	10.9			43	23	0.70	0.21	0.71					0.42																
11/19/85	290		1025		3.0	10.6			9	4	5.70	0.43	2.86		21.0	21.0	1.36	0.45	2.13															
11/19/85	300		830		2.0	10.6			4	4	0.70	0.21	0.71					0.39																
07/09/86	210		1110		3.5	24.5		31.27			0.70	0.21	2.86					0.39																
07/09/86	220		1025		12.0	19.4		31.85			1.40	0.21	2.14					0.52																
07/09/86	230		1015		11.0	17.9		31.95			0.70	0.21	2.14		<7.0	<7.0	0.29	0.52	0.74															
07/09/86	240		1235		3.5	26.4		29.81			0.70	0.21	2.86					0.48																
07/09/86	250		1200		4.5	26.1					2.10	0.29	2.86		21.0	21.0	1.20	1.32	4.46															
07/09/86	260		1140		4.5	22.6		31.46			1.40	0.21	2.86		14.0	<7.0	1.03	1.10	2.10															
07/09/86	270		1155		7.5	25.6		30.94			1.40	0.21	5.71		29.0	<7.0	2.00	1.65	2.20															
07/09/86	280		1305		2.5	26.0		30.15			1.40	0.29	2.86					0.39																
07/09/86	290		1110		3.5	23.7		31.47			1.40	0.21	2.86					0.52																
07/09/86	300		930		3.0	25.1					1.40	0.29	2.86					0.36																
03/25/87	210		1307		8.0	9.8	9.8	28.39	<3	<3	0.70	0.14	1.43					0.29																
03/25/87	230		1243		8.0	7.8	9.4	29.01			0.70	0.14	0.71		29.0	21.0	0.65	0.29	1.00															
03/25/87	240		1351		5.0	10.6	9.6	27.87	<3	<3	2.10	0.21	4.28					0.29																
03/25/87	250		1346		8.0	10.6	9.4	29.54	<3	<3	1.40	0.21	2.14		21.0	21.0	0.61	0.29	0.94															
03/25/87	260		1323		5.0	10.4	9.8	31.39	<3	<3	1.40	0.14	1.43					0.42																
03/25/87	270		1330		4.0	11.4	10.2	31.62	240	93	0.70	0.14	0.71		121.0	14.0	0.74	0.39	0.94															
03/25/87	280		1402		5.0	9.4	9.4	26.97	<3	<3	0.70	0.14	0.71					0.32																
03/25/87	290		1259		6.0	10.0	9.2	29.27	<3	<3	0.70	0.21	1.43					0.32																
03/25/87	300		1125		8.0	8.2	9.7	27.46	<3	<3	0.70	0.14	0.71					0.32																
06/28/88	210		0																									50170		2.0	2.1			
06/28/88	240		0																									865						
[illegible]/28/88	[illegible]		[illegible]		6.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		11.4	[illegible]	3.9[illegible]	[illegible]	4.[illegible]	[illegible]								[illegible]		[illegible]	[illegible]			

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DATE	STAT	Loc.	TIME	DEPTH Ft.	SECCHI Ft.	TEMP °C	DO mg/l	SALINITY ‰	TOT. COLI. MPN/100ml	FEC. COLI. (	NH3_N	NO2_N	NO3_N	COMB. NO_N ug. atoms / liter	TKN	TOKN	TDPO4_P	OPO4_P	TPO4_P	SI_O3)	TOC (	DOC	TC	TSS mg./liter	VSS	BOD5	BOD20)	Aureo Cells /ml.	Small Cells /ml.	Chlor Total	Chlor Filt.	COND	FLOW24	pH
06/28/88	270		0																									0						
06/28/88	280		1325		2.0	22.7	8.0	29.35	<2	<2	1.71			1.07	<4.0	<4.0	2.40	0.30	3.78	33.00								106683		15.9	14.6			
07/07/88	250		1000		7.5	24.7		29.04	4	2	2.60			0.40	19.0	4.0	2.29	36.50	3.33	23.71								917						
07/07/88	280		1030		2.5	24.8		28.95	2	2	2.40			1.14	41.0	14.3	2.45	0.29	4.81	43.47								307075		19.0	14.1			
07/25/88	250		1020		6.0	25.0	5.1	27.95	170	130																		0		5.7	2.9			
07/25/88	280		1050		4.0	25.1	6.0	28.21	240	130																		7958		14.6	13.7			
08/01/88	250		1120		4.5	27.8	5.2	28.24	30	8																		0		14.5	16.5			
08/01/88	280		1100		2.5	27.7	6.3	29.07	8	2																		1038		16.5	20.7			
08/10/88	250		1030		5.0	28.7	6.1	30.53																				0		10.4	1.6			
08/10/88	280		1050		4.0	28.6	6.2	29.51																				0		11.7	2.4			
09/07/88	250		1120		7.0	20.5	6.0	29.85	50	30																		0		4.9	2.0			
09/07/88	280		1100		5.0	20.6	6.0	29.45	4	2																		0		18.3	5.3			
09/14/88	250		1135		5.5	20.8	7.3	28.87		240																		0		7.7	2.0			
09/14/88	280		1120		3.0	20.4	7.6	28.65	240	130																		0		7.9	6.2			
09/21/88	250		1100		3.5	21.6	7.1	29.49	500	130	2.60							0.87										0		8.4	4.4			
09/21/88	280		1040		3.5	21.5	7.2	28.12	50	17	1.64			0.60				0.42		5.06								0		9.2	4.4			
10/05/88	250		1050		7.0	17.3	6.6	30.22	80	50																		0		2.2	1.3			
10/05/88	280		1035		4.5	17.1	6.8	30.02	2	2																		0		5.7	4.4			
11/09/88	250		1305		5.5	10.8		28.38	50	22	10.42			7.93				0.30		11.00	2.1	2.0						0		1.1				
11/09/88	280		1250		5.0	10.4		27.88	30	30	9.07			5.90				0.30		10.64	2.5	1.9						0		3.8	1.8			
12/01/88	250		1205		5.0	7.4	9.5	28.23	130	80	3.00			10.70				0.36		8.19	1.7	1.2						0		1.3	0.9			
12/01/88	280		1145		3.5	7.1	9.8	26.96	30	23	2.10			5.40				<0.16		<1.00	3.3	1.6						2422		22.1	5.3			
01/30/89	250		1215		4.0	4.3	14.4	30.26	140	60	<0.40			1.36	24.0	32.0	2.40	<0.16	2.80	<1.00	0.8	0.2		29.0				0		17.5	2.7			
01/30/89	280		1150		4.5	3.4	13.6	27.98	30	30	<0.40			1.07	22.0	14.3	2.00	<0.16	1.97	<1.00	1.9	0.8		28.0				0		31.0	2.2			
04/10/89	250		1040		2.5	9.6	10.8	26.52	23	4	2.14			1.86	14.3	<3.6	1.74	<0.16	2.97	17.30	3.8	2.5		23.0				818						
04/10/89	280		1024		2.5	9.4	10.3	24.81	50	4	1.64			0.93	<3.6	<3.6	1.45	<0.16	2.46	14.95	4.0	2.9		16.0				1559						
05/03/89	250		1202		4.0	13.8	8.8	29.12	240	130	3.78	0.71			<3.6	<3.6	1.32	<0.16	1.97	15.98	1.9	2.3		33.0	30.0			207		9.3	3.3			
05/03/89	280		1140		3.5	14.1	8.9	26.43	13	4	3.43	1.21			28.6	<3.6	1.26	<0.16	2.39	15.06	2.8	2.0		41.0	34.0			9748		16.0	5.0			
05/22/89	250		1105		3.0	21.2	8.4	21.47	8	8	1.00	0.43			35.7	<3.6	<0.32	<0.16	1.84	14.95	5.0	3.2						207		23.0	20.0			
05/22/89	280		1035		5.0	20.0	7.6	21.80	80	30	1.28	5.43			<3.6	<3.6	<0.32	<0.16	1.10	20.26	4.1	3.4						207		6.8	4.5			
06/12/89	250		1254		2.5	22.2		24.31	30	8	2.36	0.36			21.4	<3.6	1.16	<0.16	2.84	14.06	6.9	3.2						15343		32.0	16.0			
06/12/89	280		1324		3.5	21.8		22.77	8	2	1.78	0.57			<3.6	<3.6	1.23	<0.16	1.65	14.56	5.5	4.0						4770		9.2	5.9			
07/24/89	250		1055		3.0	25.9	7.2	24.06			1.78			0.43	<3.6	<3.6	1.23	<0.16	2.94	14.45								0		27.0	26.0			
07/24/89	280		1037		3.0	25.5	7.1	23.13			0.86			0.50	14.3	<3.6	1.55	<0.16	2.78	49.98								521		19.0	18.9			
08/08/89	250		1009		5.0	24.9	5.7	27.93			7.00			2.64	20.7	<3.6	2.07	0.90	3.36	153.01								104		9.5	8.5			
08/08/89	280		947		3.0	25.2	5.9	25.65			3.21			0.71	33.6	20.7	1.39	0.19	2.68	46.24								622		16.9	16.0			
08/31/89	250		1045		6.5	23.9	4.9	28.00	240	130	12.21			3.71	<3.6	<3.6	2.71	1.32	3.36	38.34								0		5.5	4.0			
08/31/89	280		1026		3.5	23.5	6.5	24.13	130	23	1.78			0.79	14.3	<3.6	1.39	0.23	2.58	30.22								104		15.0	15.0			
09/12/89	250		707		5.0	25.3	5.9	27.12	30	8	4.00			1.86	<3.6	<3.6	2.23	<0.16	3.13	45.39								0		10.5	8.5			
09/12/89	280		734		3.5	24.9	6.5	24.55	4	2	1.07			<0.36	14.3	<3.6	2.46	1.20	2.75	36.13								1037		11.0	10.0			
09/27/89	250		1106		6.0	17.5	7.8	27.09	240	130	22.99			7.07	14.3	<3.6	1.58	0.55	2.20									0		7.0	2.9			
09/27/89	280		1351		3.5	18.1	8.4	23.88	30	23	1.00			0.86	21.4	<3.6	<0.32	<0.16	1.84									104		20.5	16.0			
10/12/89	250		1000		6.5	14.1	8.8	29.40	13	4	3.14			1.50	22.1	15.7	3.68	0.55	3.84	33.07								0		2.9	2.3			
10/12/89	280		945		5.0	14.2	8.4	24.89	2	2	0.57			0.57	38.6	17.1	2.88	<0.16	3.36	33.61								0		7.5	7.5			
11/08/89	250		1148		6.0	12.0	9.0	21.90	130	50	32.99			127.09	38.6	22.1	<0.32	0.23	<0.32	64.54	3.0	2.4		25.0	<1.0					6.0	5.0			
11/08/89	280		1130		3.0	12.3	9.0	22.35	23	23	1.43			2.79	38.6	22.1	<0.32	0.16	<0.32	37.24	4.4	3.0		9.0	3.0					14.5	14.5			
11/27/89	250		1117		5.0	4.3	10.4	30.10			14.14			16.92	12.1	<3.6	1.65	0.65	2.55	29.01	1.4	1.4		41.0	12.0			104		1.0	0.4			
11/27/89	280		1101		3.5	3.0	11.0	27.29	50	13	14.07			21.56	17.9	21.4	2.75	0.29	2.78	33.89	2.1	1.7		13.0	5.0					2.3	1.2			
03/19/90	250		1029		3.5	10.9	9.0	29.86	30	2	<0.36			0.57	<3.6	<3.6	2.58	<0.16	3.20	5.45	2.9	2.4		13.0	11.0			0		26.0	4.3			
03/19/90	280		1052		3.0	10.7	8.7	27.82	17	4	<0.36			1.57	11.4	<3.6	2.36	<0.16	3.29	3.67	3.3	4.3		11.0	7.0			0		14.5	7.8			

C:\DBASE\CRUISE\GSB.DBF DATABASE

DATE	STAT	Loc.	TIME	DEPTH Ft.	SECCHI Ft.	TEMP °C	DO mg/l	SALINITY ‰	TOT. COLI. MPN/100ml	FEC. COLI. MPN/100ml	NH3_N (	NO2_N	NO3_N	COMB. NO_N ug. atoms / liter	TKN	TDKN	TDPO4_P	OPO4_P	TPO4_P	SI_O3)	TOC (	DOC	TC	TSS mg./liter	VSS	BOD5	BOD20)	Aureo Cells /ml.	Small Cells /ml.	Chlor Total	Chlor Filt.	COND	FLOW24	pH
04/09/90	250		1151		4.0	8.2	10.2	29.29	23	8	<0.36			0.57	<3.6	<3.6	1.81	<0.16	3.39	7.12	2.1	1.8		17.0	7.0			0		7.3	4.0			
04/09/90	280		1214		2.0	7.9	9.4	26.36	7	7	<0.36			<1.21	<3.6	<3.6	1.58	<0.16	3.13	6.98	3.3	2.5		46.0	11.0			0		9.3	6.5			
05/01/90	250		1156		3.5	16.0	8.2	26.24	170	30	3.71			8.28	54.3	49.3	2.42	<0.16	2.97	14.35	3.0	3.5		16.5	4.5			0		9.0	6.3			
05/01/90	280		1224		3.5	15.5	8.8	26.57	17	2	<0.36			0.57	42.8	30.0	1.81	0.23	4.17	3.24	3.8	3.2		26.0	9.0			830		18.5	11.0			
05/15/90	250		1333		4.5	17.3	9.3	28.14	4	<2	0.71			0.43	<3.6	<3.6	1.13	<0.16	1.52	32.68								830						
05/15/90	280		1402		4.0	17.4	9.6	25.67	<2	<2	0.43			<0.36	35.0	<3.6	1.03	<0.16	1.94	19.79								1244						
06/13/90	210		1426		8.0	21.8	8.2	27.70			<0.36			0.50			1.68	<0.16	2.58	22.46														
06/13/90	220		1333		20.0	16.8	8.0	30.53			<0.36			<0.36			1.74	<0.16	1.91	23.32														
06/13/90	230		1315		11.0	16.0	7.8	30.62			<0.36			<0.36			1.84	<0.16	2.46	24.28														
06/13/90	240		1545		3.5	22.1	9.8	26.22			<0.36			0.64			1.32	<0.16	2.42	23.82														
06/13/90	250		1530		5.0	21.8	9.5	26.70			<0.36			0.64			1.13	<0.16	2.20	24.39								3111						
06/13/90	260		1454		6.0	21.5	9.1	29.52			<0.36			0.57			2.13	0.23	2.36	31.15														
06/13/90	270		1508		7.0	21.0	9.4	28.10			<3.57			0.50			<0.32	<0.16	1.81	26.20														
06/13/90	280		1626		5.0	21.4	7.5	26.27			0.36			0.36			<0.32	<0.16	2.71	22.61								7052						
06/13/90	290		1412		10.0	19.9	6.4	28.00			1.57			0.43			1.68	0.39	1.91	27.34														
06/13/90	300		1010		5.5	19.7	7.2	25.28			<0.36			0.36			<0.32	<0.16	1.52	21.22														
07/18/90	250		940		7.0	25.3	5.8	28.43	17	8	2.07			1.00	45.0	30.7	1.81	1.13	2.52	41.72								207						
07/18/90	280		915		5.0	24.9	5.9	26.35	13	8	<0.36			0.57	43.5	35.0	<0.32	<0.16	1.49	44.57								1865						
08/08/90	250		925		5.0	24.6	5.1	28.30	27	17	14.21			4.21	77.1	64.3	2.71	2.00	3.84	48.70								0						
08/08/90	280		1058		3.0	24.6	6.8	26.71	23	8	<0.36			0.93	87.8	58.5	<0.32	0.19	2.26	46.99								227						
10/11/90	250		1127		4.0	21.1	6.6	29.04	70	8	7.00			8.57	45.0	41.4	1.39	0.52	1.84	25.77								0						
10/11/90	280		1158		2.0	20.9	7.1	26.65	4	4	1.43			1.00	60.7	41.4	1.81	<0.16	2.71	29.37								227						
12/12/90	250		1150		6.5	4.3	12.0	27.23	13	4	3.71			19.28	16.4	15.7	1.26	<0.16	2.26	25.06								114		5.0	3.0	12.0		
12/12/90	280		1214		3.5	4.0	12.1	26.93	4	2	<0.36			1.57	22.9	23.6	<0.32	<0.16	1.42	9.68								3632		11.7	8.7			
01/15/91	250		1256		3.5	1.4	12.5	20.70	240	80	57.12			42.84	71.4	64.3	1.91	0.16	2.20									114		4.2	3.5			
01/15/91	280		1321		3.5	1.5	12.0	24.92	13	8	<0.36			7.78	25.7	12.1	1.10	<0.16	2.33	8.79								5335		14.5	9.2			
03/18/91	250		1115		5.5	5.9	13.2	30.20	50	50	0.93			0.79	18.6	17.1	1.74	<0.16	1.74	10.75								0		4.5	3.5			
04/08/91	250		1209		5.0	14.9	8.0	29.08	2	<2	<0.36			<0.36	28.6	<3.6	1.23	<0.16	2.00	12.07								1419		19.5	5.2	11.5		
04/08/91	280		1236		4.5	14.9	9.7	26.59	13	8	<0.36			<0.36	32.8	11.4	0.97	<0.16	2.29	11.32								1986		7.5	7.0			
05/08/91	250		1315		4.0		9.7	27.67	30	13	3.21			3.21	25.7	15.7	1.13	<0.16	2.07	19.01								4709		10.7	7.5			
05/08/91	280		1343		4.5	16.6	9.4	25.99	2	<2	<0.36			0.50	31.4	19.3		<0.16		11.50								6722		6.5	5.0			
06/11/91	250		1318		5.5	25.0	9.5	29.12	13	4	<0.36			0.50	21.4	19.3	2.26	1.36	2.97	18.90								0		3.7	4.2			
06/11/91	280		1345		3.0	24.5	9.1	28.00	4	4	<0.36			0.50	25.7	25.0	1.81	0.45	1.20	42.36								227		6.5	6.7			

REVIEW OF COLIFORM DATA
SHELLFISH LAND # 3
GREAT SOUTH BAY
SUFFOLK/NASSAU LINE TO
ROBERT MOSES CAUSEWAY

PREPARED: JUNE 1992

STATE OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
BUILDING 40, SUNY
STONY BROOK, NEW YORK 11790-2356

by: Charles de Quillfeldt
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INTRODUCTION

It is the intent of this report to review water quality for the certified and uncertified portions of Shellfish Growing Area # 3, Great South Bay west of the Robert Moses Causeway within the Towns of Babylon and Islip. The report will evaluate water quality in relation to the criteria set out in 6 NYCRR 47, Certification of Shellfish Lands, to determine whether the area is properly classified.

NOTES

1. The Department is grateful for the assistance received from the Town of Babylon, particularly Mike Litwa of the Babylon Department of Environmental Control, Chief Harbormaster Fred Fricano and the Babylon Bay Constables.

2. Precipitation data were received from stations located in Amityville(0600 recording), Belmont Lake State Park(1700 recording) and Lindenhurst(0600 recording).

3. Water quality and precipitation data are compiled at the rear of the report.

4. Adverse Pollution Conditions(APC) mean samples were collected on an outgoing tide following precipitation of 0.25 - 2.99 inches within 0 - 96 hours of sampling. Extraordinary Conditions(XS) means samples were collected following rainfalls of 3.00 inches or greater within 0 - 96 hours of sampling or following extraordinarily high tides associated with storm events.

5. The 1990 water quality evaluation of the north side of Area 3, communications with the Town of Babylon and a 1990 evaluation of the south side of the bay are attached at rear of the report. A full report was not written at that time; however, the 1990 evaluation led to the closure of 1300 acres in the northwestern portion of the area. Subsequent to this closure, additional sampling stations (59.3, 54.1 and 46) were developed to determine whether some of the uncertified area could be reopened.

RESULTS - CERTIFIED AREA

The following tables summarize bacteriological water quality at stations in and adjacent to the certified portion of Area 3.

AREA 3. GREAT SOUTH BAY. BACTERIOLOGICAL WATER QUALITY DATA.

Criteria. Water quality at a station is acceptable if one of the following criteria are met:

Total Coliform - Median total coliform MPN/100ml of 70 or less, no more than 10 % of the samples in excess of an MPN/100ml of 330; or

Fecal Coliform - Median fecal coliform MPN/100ml of 14 or less, no more than 10% of the samples in excess of an MPN/100ml of 49.

A. North Side APC Sampling Data. April 1989 - May 1992.
* means station exceeds bacteriological criteria

		TOTAL COLIFORM MPN/100ml		FECAL COLIFORM MPN/ 100ml	
Station	# Samples	Median	%> 330	Median	%> 49
5	29	23	0	15	13.8
4.1*	31	23	12.9	9	16.1
59.2*	30	43	16.7	13.5	16.7
59.3	15	15	6.7	4	20
55.1*	28	93	14.3	16	21.4
54 *	27	93	22.2	23	33.3
54.1	13	7	0	<3	7.7
50.1*	28	43	35.7	9	32.1
45 *	29	93	20.7	23	31
46	13	23	7.7	4	0
41 *	30	23	20	9	13.3
40	30	19	10	9	16.7
40.2	27	9	3.7	9	11.1
34.2	29	23	6.9	15	20.7
34.3	29	43	10.3	4	3.4
26	22	43	4.5	6.5	13.6
20.1	34	31	5.9	7	11.8
20	39	23	2.6	9	2.6
19	27	9	0	3	3.7
20.2	32	23	6.3	9	3.1
23.1*	27	93	7.4	23	14.8
22	30	33	10	9	10
21	15	4	0	<3	0

B. South Side APC Sampling Data. September 1988 - May 1992.
* means station exceeds bacteriological criteria

		TOTAL COLIFORM MPN/100ml		FECAL COLIFORM MPN/100ml	
Station	# Samples	Median	%> 330	Median	%> 49
x 6	18	20	0	9	5.6
x 6.1	8	9	0	5.5	0
x 7	8	9	0	3	0
x 7.1	17	15	0	4	0
8	8	17	0	6.5	0
8.1	17	15	0	7	11.8
9	8	11	0	4	0
9.1	17	9	0	9	0
10 *	8	29	12.5	15	25
10.1	17	23	5.9	9	17.6
11	8	9	0	9	0
11.1	18	23	0	9	5.6
12	15	23	0	9	13.3
12.1	14	23	0	8	0
x 13	20	21.5	0	9	5
x 14	18	22	0	9	11.1
x 15	12	9	0	6.5	0
x 16	21	23	0	23	0
x 17	20	34	0	23	15

C. North Side XS Sampling Data. April 1989 - May 1992.
* means station exceeds bacteriological criteria

		TOTAL COLIFORM MPN/100ml		FECAL COLIFORM MPN/100ml	
Station	# Samples	Median	%> 330	Median	%> 49
5 *	4	33	25	33	25
4.1*	4	23	25	23	25
59.2	4	68	0	19	0
59.3	3	93	0	6.2	0
55.1*	5	93	20	9	20
54	1	--	--	--	--
54.1	3	14	0	4	0
50.1*	2	--	50	--	50
45 *	4	240	25	93	100
46 *	3	240	33.3	93	66.7
41 *	6	1100	66.7	166.5	66.7
40 *	6	350	50	93	66.7
40.2*	5	460	80	150	60
34.2*	4	1100	75	93	100
34.3*	5	≥2400	80	150	60
26	1	--	--	--	--
20.1*	7	240	14.3	43	42.9
20 *	8	166.5	37.5	43	50
19 *	7	93	14.3	39	28.6
20.2*	7	460	57.1	43	42.9
23.1	1	--	--	--	--
22 *	6	240	33.3	68	50
21 *	4	240	0	68	50

D. South Side XS Sampling Data. September 1988 - May 1992.
* means station exceeds criteria

		TOTAL COLIFORM MPN/100ml		FECAL COLIFORM MPN/100ml	
Station	# Samples	Median	%> 330	Median	%> 49
x 6 *	4	166.5	0	33	25
x 6.1	1	--	--	--	--
x 7	1	--	--	--	--
x 7.1*	3	75	33.3	23	0
8	1	--	--	--	--
8.1*	4	93	25	33	25
9	1	--	--	--	--
9.1*	3	240	0	93	66.7
10	1	--	--	--	--
10.1*	3	1100	66.7	1100	100
11	1	--	--	--	--
11.1*	4	460	75	251.5	50
12 *	3	240	33.3	43	33.3
12.1*	3	240	0	93	100
x 13 *	6	240	16.7	58	50
x 14 *	6	240	33.3	93	66.7
x 15 *	3	240	33.3	93	66.7
x 16 *	5	240	20	93	80
x 17 *	5	460	60	43	40

Water quality throughout the certified portion of Area 3 is generally acceptable except at stations 23.1 and 4.1, at the eastern and western ends of the growing area, respectively. Station 10(Cedar Beach Marina) exceeds criteria; however, this area is seasonally closed(May 15 - Sept. 30). No pollution sources exist in this area during the seasonally certified period.

Portions of the uncertified area also exhibit acceptable water quality. Stations 26, 40, 46, 54.1 and 59.3 meet the criteria for a certified shellfish land. Stations 40, 46, 54.1 and 59.3 are located in the southern portion of the 1300 acre area closed in 1990.

Bacteriological data are summarized in map form on Chart 1(Bacteriological Data), Chart 1a(Total Coliform Data) and Chart 1b(Fecal Coliform Data).

RECOMMENDATIONS

The existing closure line(Chart 2) in the northern portion of Area 3 should be adjusted to reflect both the unacceptable water quality at stations 23.1 and 4.1, in the currently certified area, and the acceptable water quality found at stations 26, 40, 46, 54.1 and 59.3 in the uncertified area. A triangular closure should remain in place along Fox Creek Channel because station 40 is only marginally acceptable. A reevaluation of this section will be made

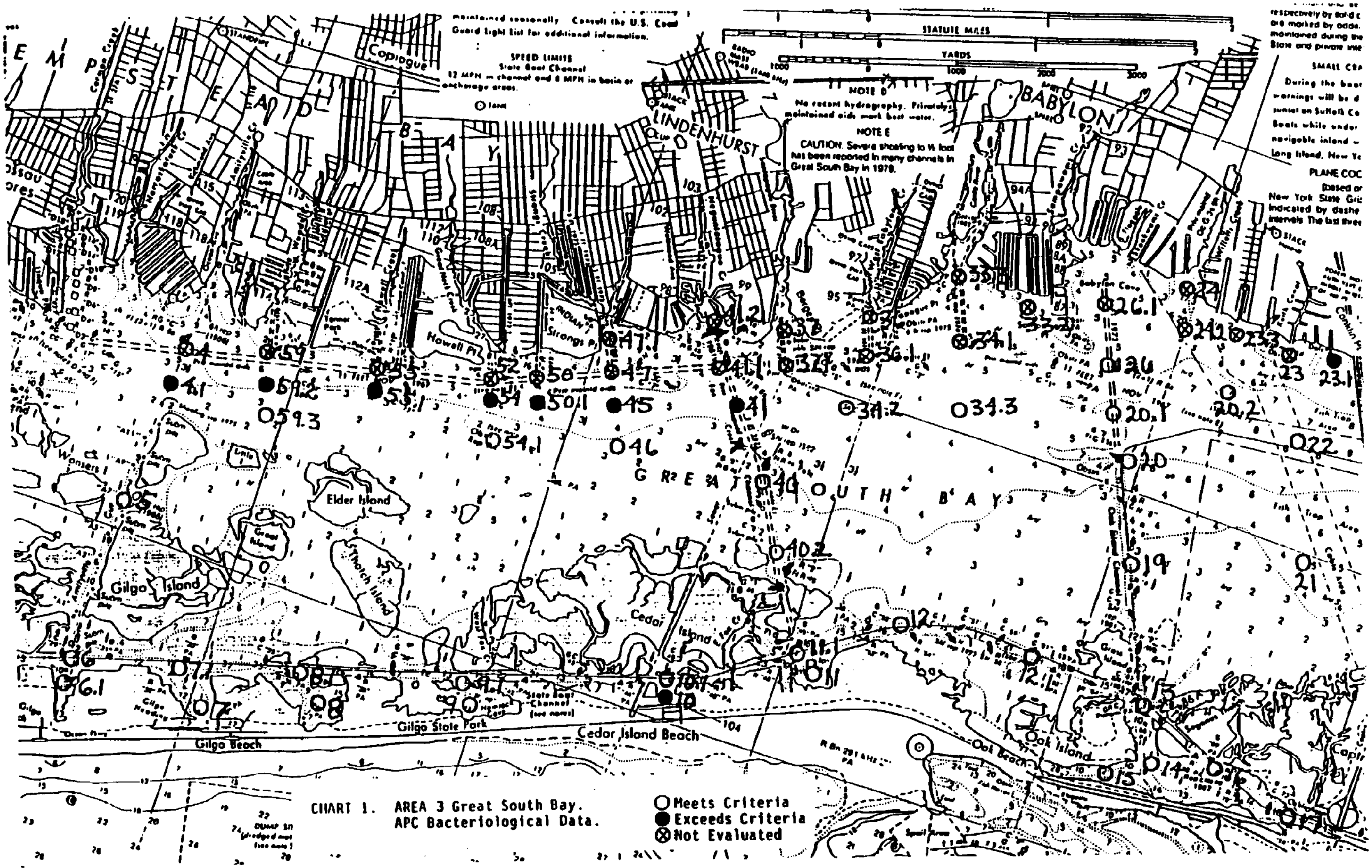


CHART 1. AREA 3 Great South Bay. APC Bacteriological Data.

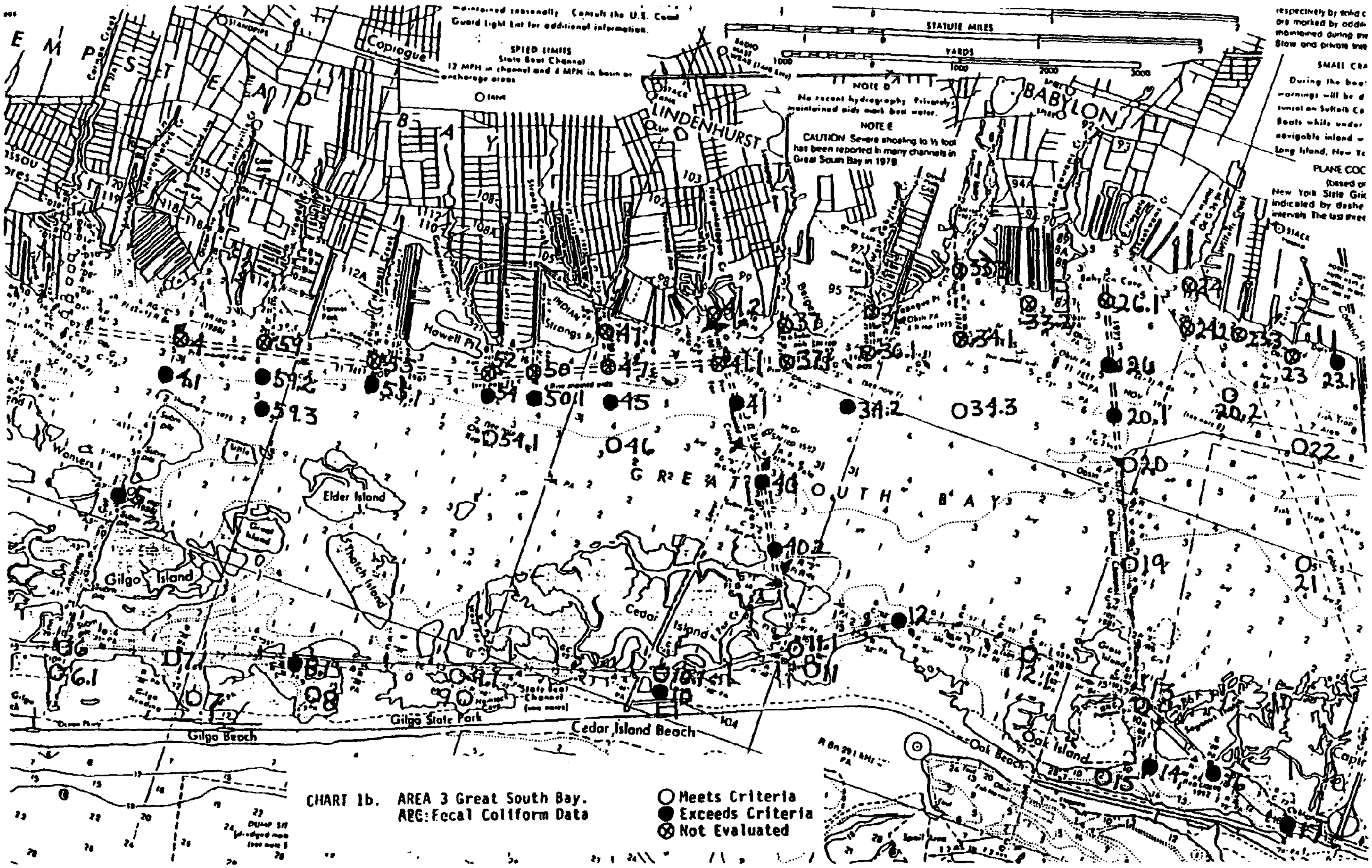


CHART 1b. AREA 3 Great South Bay.
ABC: Fecal Coliform Data

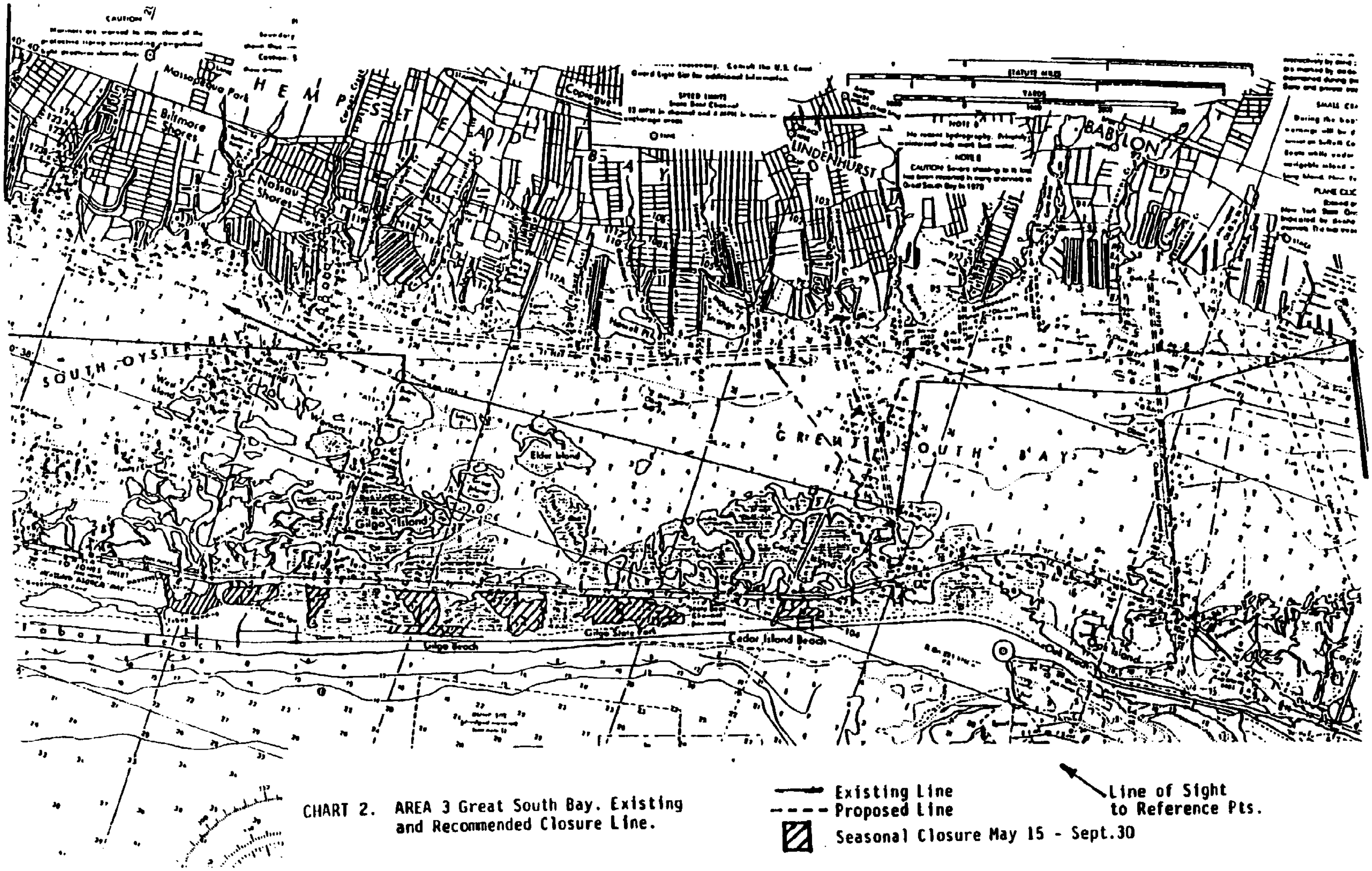


CHART 2. AREA 3 Great South Bay. Existing and Recommended Closure Line.

Existing Line
Proposed Line
Seasonal Closure May 15 - Sept.30
Line of Sight to Reference Pts.

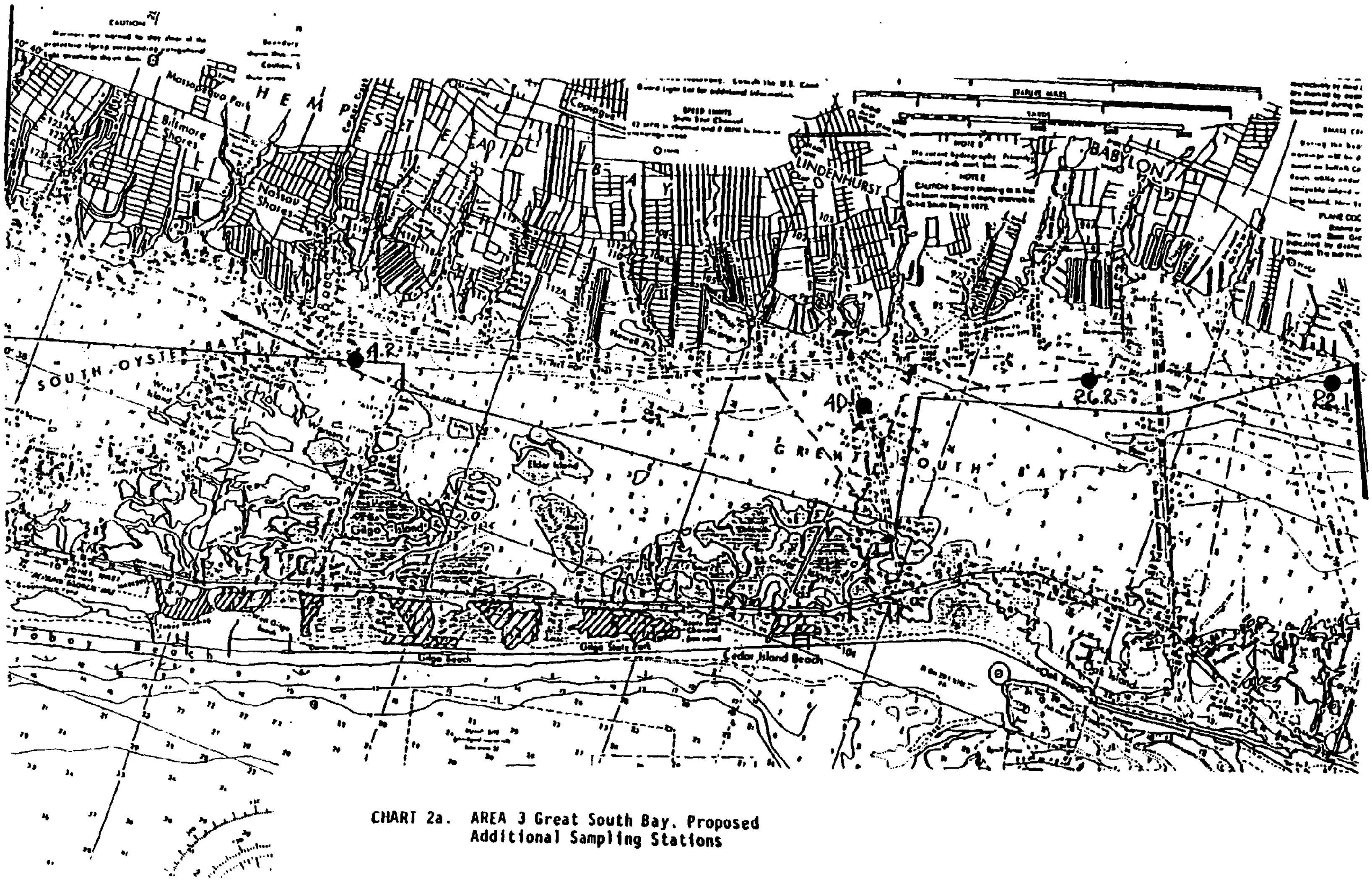


CHART 2a. AREA 3 Great South Bay. Proposed Additional Sampling Stations

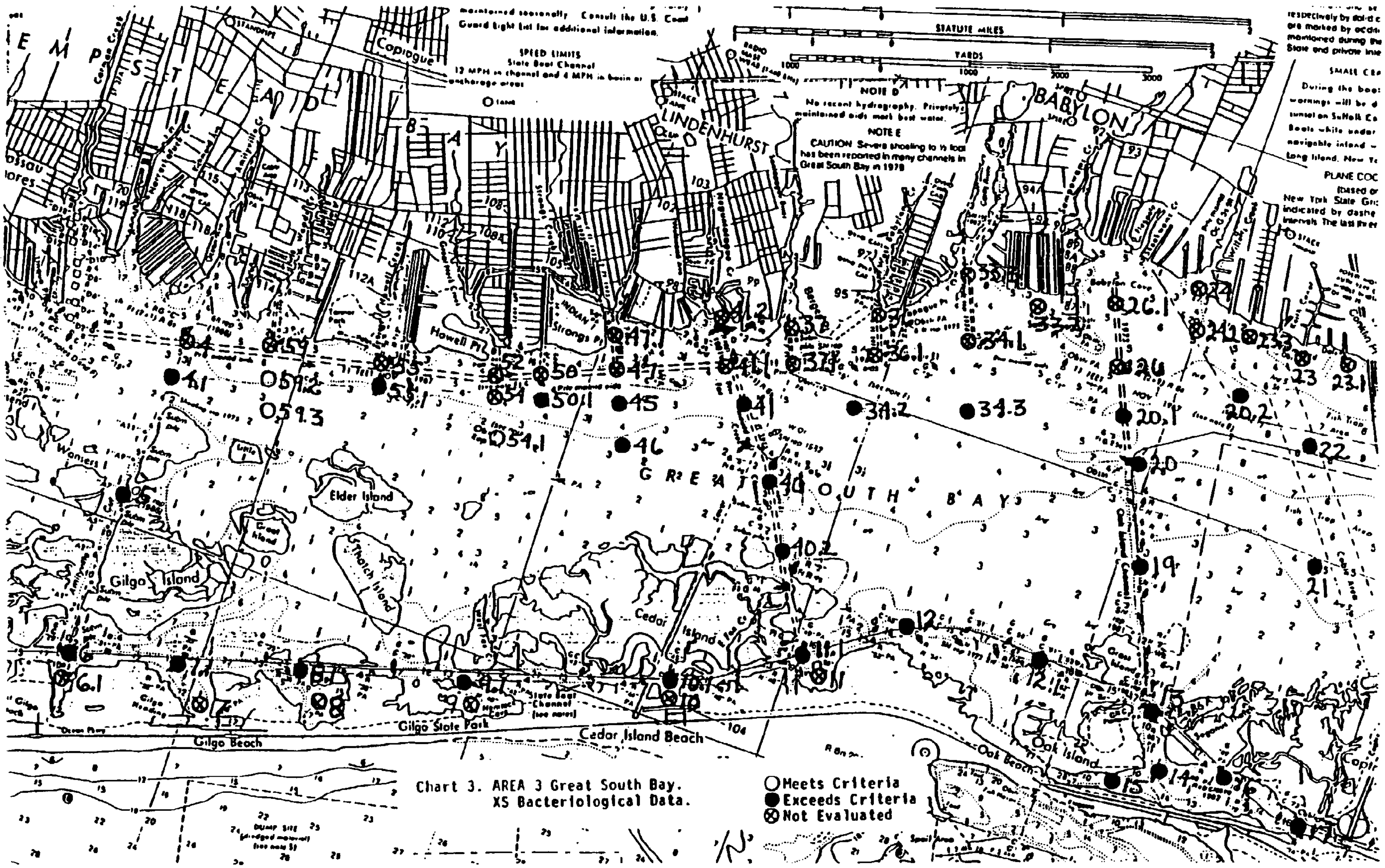


Chart 3. AREA 3 Great South Bay.
XS Bacteriological Data.

following further data collection. The channel seems to be a conduit that carries pollution from the mainland further out into the bay.

The recommended closure line (Chart 2) is based on water quality and identifiable landmarks. Extensive buoying will still be necessary to mark the uncertified area but the buoys will no longer be part of the written description. Landmarks will be verified in a field survey prior to initiation of rulemaking. New stations will be added : 22.1, south of 23.1; 26.2, west of 26; 40.1,between 40 and 41; and 4.2, west of 4.1(chart 2a).

The recommended closure line will result in the following changes in the certified and uncertified sections on the north side of Area 3:

1. Approximately 53 acres(23 adjacent to station 23.1, 30 adjacent to station 4.1) designated as uncertified.

2. Approximately 973 acres designated as certified(reopened). This is a net gain of about 920 acres in certified area, including almost half(625 acres) of the 1300 acres closed in 1990.

On the south side of Area 3, It is recommended that the seasonal closure of the marina area at Seganus Thatch be rescinded, as the marina no longer exists. This will result in about 3 acres being recertified. No other changes in the seasonal closures of the marina and transient anchoring areas along the barrier beach are contemplated at this time. The boat basins will be reevaluated to determine whether they are correctly classified.

The summary of sampling data collected following extraordinary pollution(XS) event(Tables C and D, Chart 3) indicates that all of Area 3 should continue to be closed when such events occur.

RESULTS - UNCERTIFIED AREA

A Conditional Harvesting Program has been operated in the uncertified portion of Area 3 since 1982. During this time the conditional closure line has moved extensively in the area west of Bergen Point, likely due to the close proximity to the numerous tributaries and possibly because of migratory waterfowl at the western end. East of Bergen Point, the line has not changed.

A copy of the 1991 - 1992 Conditional Program and map is attached as Chart 4. This program allowed harvesting in about 2400 acres of the normally uncertified portion of Area 3 under dry weather conditions(0.10" of precipitation or less) during the period of December - March.

The following table summarizes the bacteriological water quality data for the uncertified portion of the north side of Area 3.

New York State Department of Environmental Conservation
Building 40—SUNY, Stony Brook, New York 11790-2356

Thomas C. Jorling
Commissioner

NOTICE TO SHELLFISH HARVESTERS

Conditional Shellfishing Program in Great South Bay

Pursuant to the provisions of 6 NYCRR 47, the NYS Dept. of Environmental Conservation, in cooperation with the Towns of Babylon and Islip, will initiate a CONDITIONAL HARVESTING PROGRAM on December 11, 1991 for certain shellfish lands in Great South Bay west of the Robert Moses Causeway. In order to take advantage of the program, please note the following:

1. CONDITIONAL AREA DESCRIPTION: All that area of Great South Bay west of the Robert Moses Causeway lying south of a line extending easterly from the southeasternmost point of land at Strongs Point(Indian Island) to the southernmost point of land at Bergen Point and continuing easterly to the residence at 164 Secatogue Lane West, West Islip(Located south and east of the entrance to Willetts Creek); and,

   All that area of Great South Bay west of the Robert Moses Causeway lying east of a line extending southwesterly from the southeasternmost point of land at Strongs Point(Indian Island) to the easternmost point of land at Elder Island.

   EXCEPT all creeks, canals and tributaries.

2. CONDITIONS TO BE MET: When not more than 0.10 inches of precipitation is recorded for each of 7 successive days, the area will open on the 8th day and will remain open until more than 0.10 inches of precipitation is recorded in 24 hours. (see Special Note "b")

3. NOTIFICATION: Each day, Monday - Saturday, beginning at 6:30 A.M. a recorded message announcing the status of the area as OPEN or CLOSED can be reached at 893-1074.
   A copy of the order opening or closing the area will be posted at the NYSDEC Region 1 Office, Stony Brook, NY.
   Telephone calls regarding the program can be made to the Town of Babylon after 9:00 A.M. at 422-7640 or to NYSDEC after 8:30 A.M. at 751-6381.

4. TIME DURATION: December 11, 1991 through March 31, 1992

5. SPECIAL NOTES: This program may be suspended, revised or cancelled at any time if bacteriological water quality is found to exceed the criteria for a certified shellfish land or if any other condition is found to exist which may be a threat to public health.

   b. It has been determined that runoff from snowmelt can affect the conditional area. The area will close if there is significant runoff following snowfalls of 3 inches or greater.

Dated: December 11, 1991 Stony Brook, New York

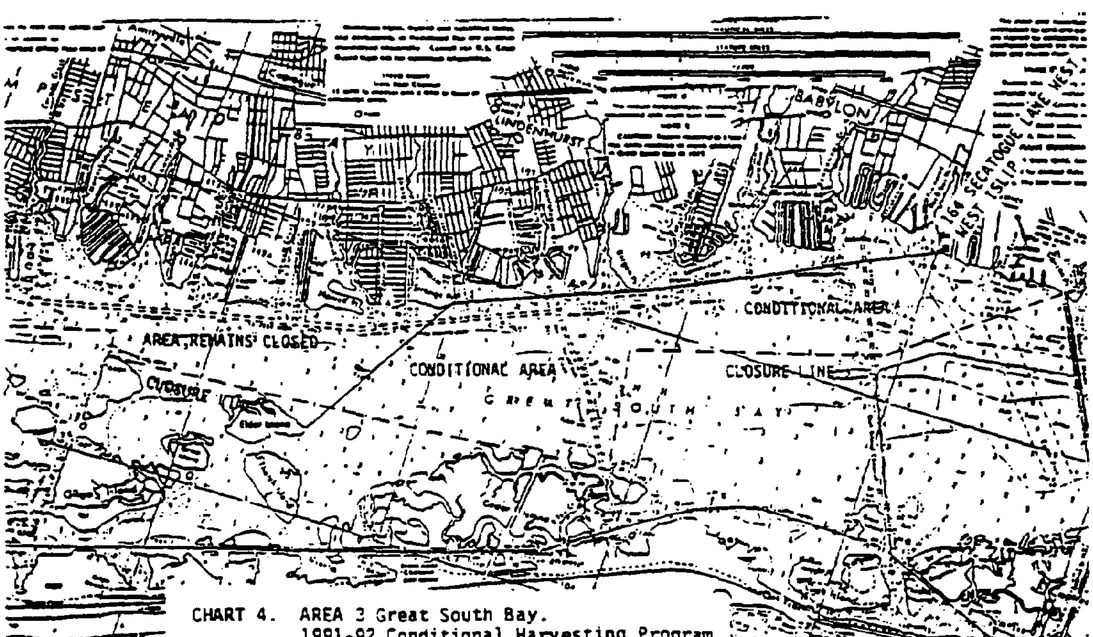


CHART 4. AREA 3 Great South Bay.
1991-92 Conditional Harvesting Program

AREA 3. GREAT SOUTH BAY. CONDITIONAL AREA EVALUATION. OCTOBER 1988 - APRIL 1992 BACTERIOLOGICAL WATER QUALITY DATA.

<u>Criteria</u>. (only total coliform is used to evaluate conditional areas)

<u>Total Coliform</u>. Median total coliform MPN/100ml of 70 or less , no more than 10% of the samples in excess of an MPN/100ml of 330.

A. Rainfalls 0 - 0.15" **B. Rainfalls 0.16 - 0.40"**

*** means station exceeds bacteriological criteria**

# Samples	Median	%> 330	# Samples	Median		%> 330	Station
4	20	23	5	5	*	240	20
4.1	17	23	5.9	6		43	0
59	20	33	0	3		43	0
59.2	17	23	0	6	*	240	33.3
59.3	14	9	0	4	*	93	0
55 *	23	43	13	3	*	93	33.3
55.1	20	23	0	6	*	240	16.7
52	26	43	7.7	5	*	150	40
54	22	23	0	7	*	150	42.9
54.1	15	9	0	4	*	18.5	0
50	26	33	3.8	5	*	460	60
50.1	20	23	5	6	*	460	66.7
47.1	20	43	5	4	*	460	75
47	25	23	4	6	*	150	16.7
45	20	12	5	6	*	166.5	33.3
46	15	9	0	3		43	0
41.2*	20	23	15	4	*	225	25
41.1	27	23	0	8	*	166.5	25
41	20	23	0	6	*	15	16.7
40	15	9	6.7	5		23	0
40.2	13	9	0	5		39	0
37	26	43	0	6	*	68	33.3
37.1	26	23	0	6	*	141.5	16.7
36	25	23	8	6	*	150	16.7
36.1	25	23	0	6	*	121.5	16.7
34.2	17	7	0	5	*	23	20
33.3	25	23	8	6	*	68	16.7
34.1	25	23	0	6	*	112.5	0
34.3	18	23	0	6	*	23	16.7
33.2	25	23	0	6		66	0
26.1	25	21	0	6	*	93	16.7
26	25	14	0	8		33	0
20.1	19	23	5.3	6		41	0
20	15	15	0	6		33	0
24	24	15	0	6		68	0
24.2	24	23	4.2	6		57	0
23.3	24	9	0	6		23	0
23	24	10	4.2	6	*	93	0
23.1	23	9	0	8		43	0
20.2	17	4	0	6		23	0

Chart 5 summarizes water quality in the conditional area under normal operating conditions. Chart 5a summarizes water quality under moderate(0.15 - 0.40") rainfall conditions.

Only stations 41.2(Neguntatogue Creek) and 55(Howells Creek) exceed the criteria for conditional certification following precipitation of 0.10" or less. All of the western section of the area and much of the eastern section exceed criteria under moderate(0.16 - 0.40") precipitation conditions, although it should be noted that this analysis is based on only a small number of samples.

RECOMMENDATIONS

Pending additional data collection during fall 1992, it is expected that a Conditional Harvesting Program can again be operated in the uncertified portion of Area 3 for the 1992 - 1993 season. Consideration will be given to expanding the conditional program into the western section, but because station 55 exceeds criteria, making it difficult to draw an enforceable line, and because the western portion has a history of variable water quality even during dry weather, extreme caution must be taken. It must also be noted that stations in South Oyster Bay, immediately west of stations 4 and 4.1 do not meet the criteria for conditional certification. If water quality data continues to support conditional certification, it is recommended that the area be divided into eastern and western zones to be operated concurrently, but which can be closed separately if the need arises.

It is also recommended that the conditional program continue to operate under the same conditions(0.10" of precipitation). Higher rainfall amounts can affect the area.

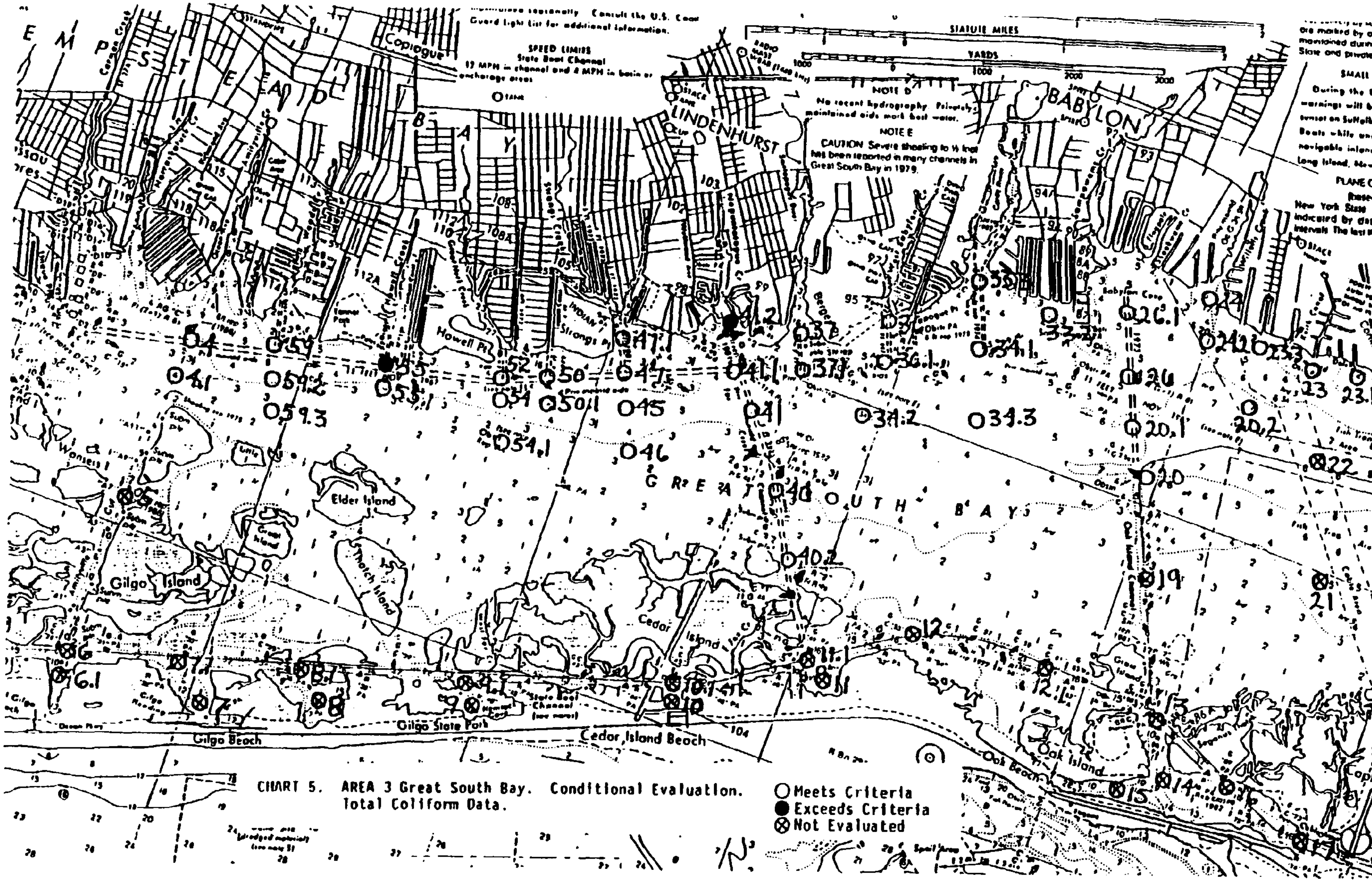


CHART 5. AREA 3 Great South Bay. Conditional Evaluation. Total Coliform Data.

○ Meets Criteria
● Exceeds Criteria
⊗ Not Evaluated

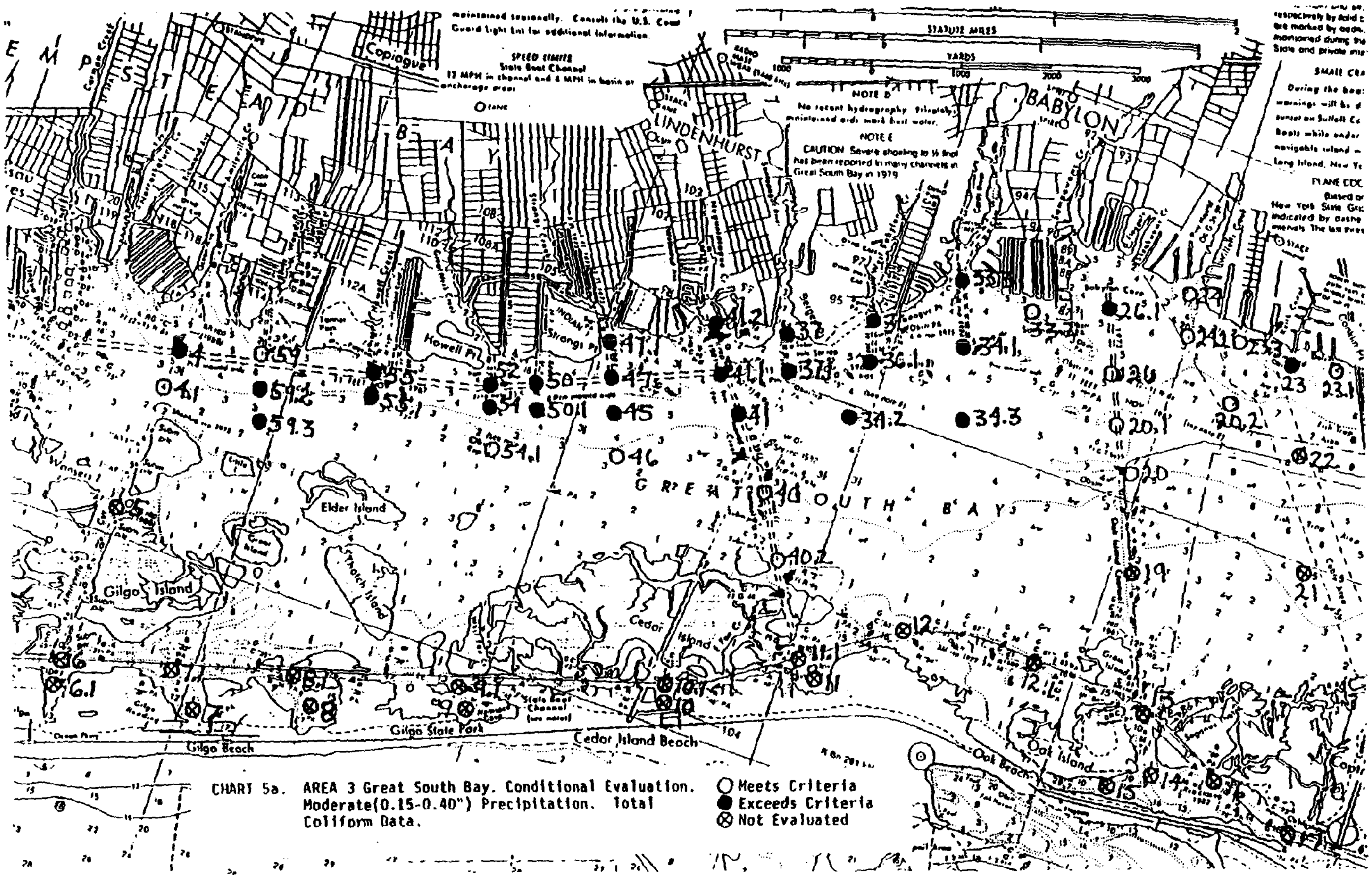


CHART 5a. AREA 3 Great South Bay. Conditional Evaluation. Moderate(0.15-0.40") Precipitation. Total Coliform Data.

○ Meets Criteria
● Exceeds Criteria
⊗ Not Evaluated

New York State Department of Environmental Conservation
Region 1 Headquarters
SUNY, Building 40, Stony Brook, NY 11794
Bureau of Shellfisheries
(516) 751-7900

Thomas C. Jorling
Commissioner

June 28, 1990

The Honorable Arthur G. Pitts
Supervisor
Town of Babylon
Town Hall
200 E. Sunrise Highway
North Lindenhurst, NY 11757

Dear Supervisor Pitts:

I have completed a review of bacteriological water quality in the north side of Great South Bay in the Town of Babylon. Sampling results indicate that there is a portion of the area, adjacent to the Copiague/Lindenhurst area, where water quality fails to meet the criteria for a certified shellfish land. Summaries of the data are attached.

Problems in the area were noted in January and February of 1990; however, follow-up sampling showed an improvement in water quality in late February - May. Sampling in mid-May following heavy (2 - 2.5 inches) rainfall again found unacceptable levels of bacteria. Resampling following reports of shellfish-related disease outbreaks where the clams' reported area of harvest were SS2 (South Oyster Bay) and SS3 (Babylon) showed that portions of the area were again affected by rainfall.

Although we strongly suspect that the shellfish which caused the illnesses were not harvested from Babylon waters, DEC is required pursuant to Environmental Conservation Law, to designate as uncertified all shellfish lands that do not meet appropriate criteria. A chart of the proposed closure is attached. It is expected that a rulemaking to designate the area as uncertified will be completed by mid-July.

Dry weather sampling indicates that it may be possible to operate a conditional harvesting program in the affected area. I hope to continue to work closely with the Town of Babylon to determine if this is possible and also to determine through additional sampling whether the size of the closure can be reduced.

Thank you for your time. If you have any questions, please contact me.

Sincerely,

Charles de Quillfeldt

Charles de Quillfeldt
Marine Resources Specialist

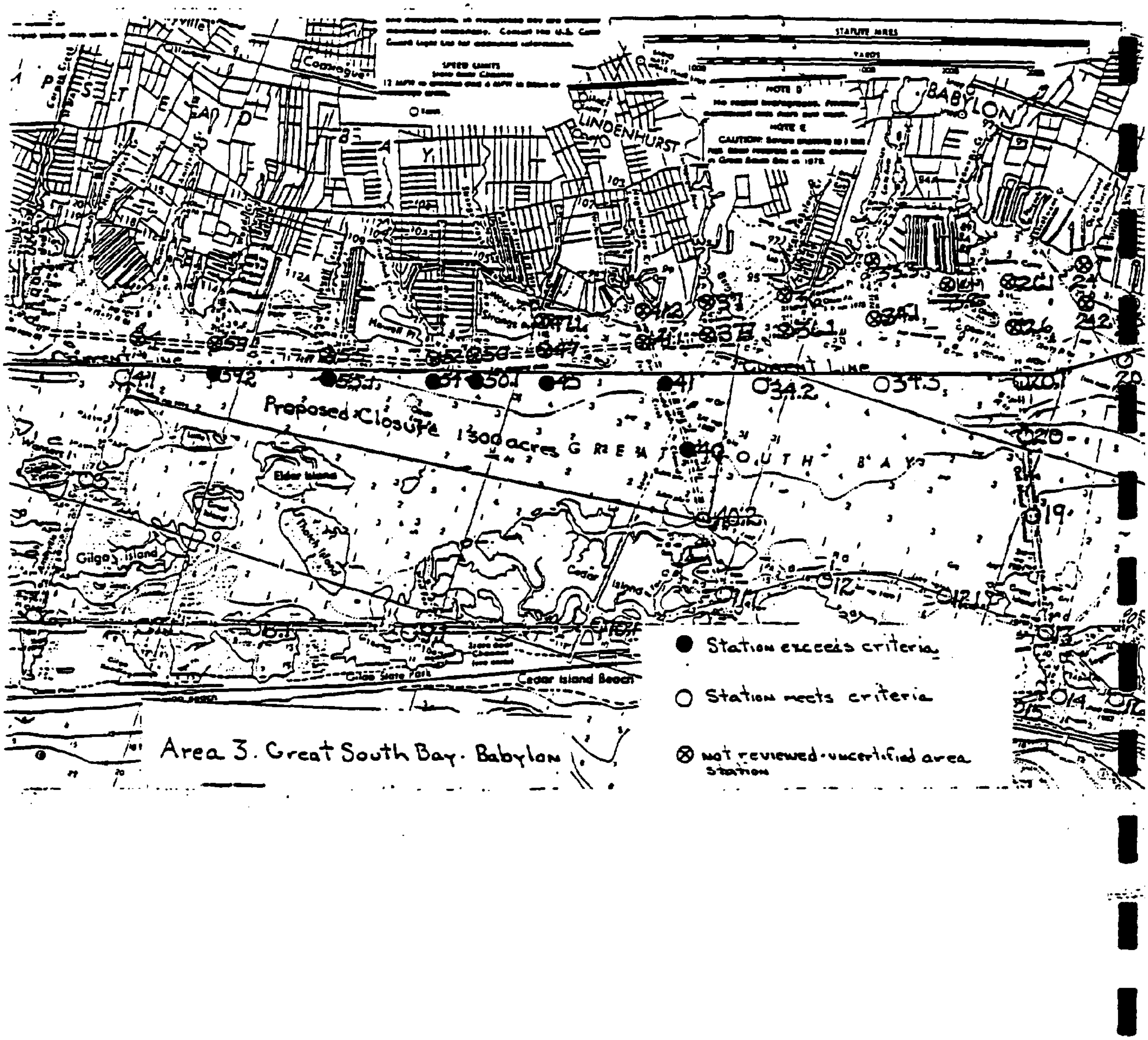
CDQ/ajs
ATTACHMENTS
cc: Gordon Colvin
Pieter VanVolkenburgh
Jean Gilman
Mike Litwa
West End Baymen's Assoc.
Town of Babylon Shellfish Commission

Bacteriological Water Quality. Great South Bay, Town of Babylon.
Wet Weather Data 1988 - June 1990. North Side.

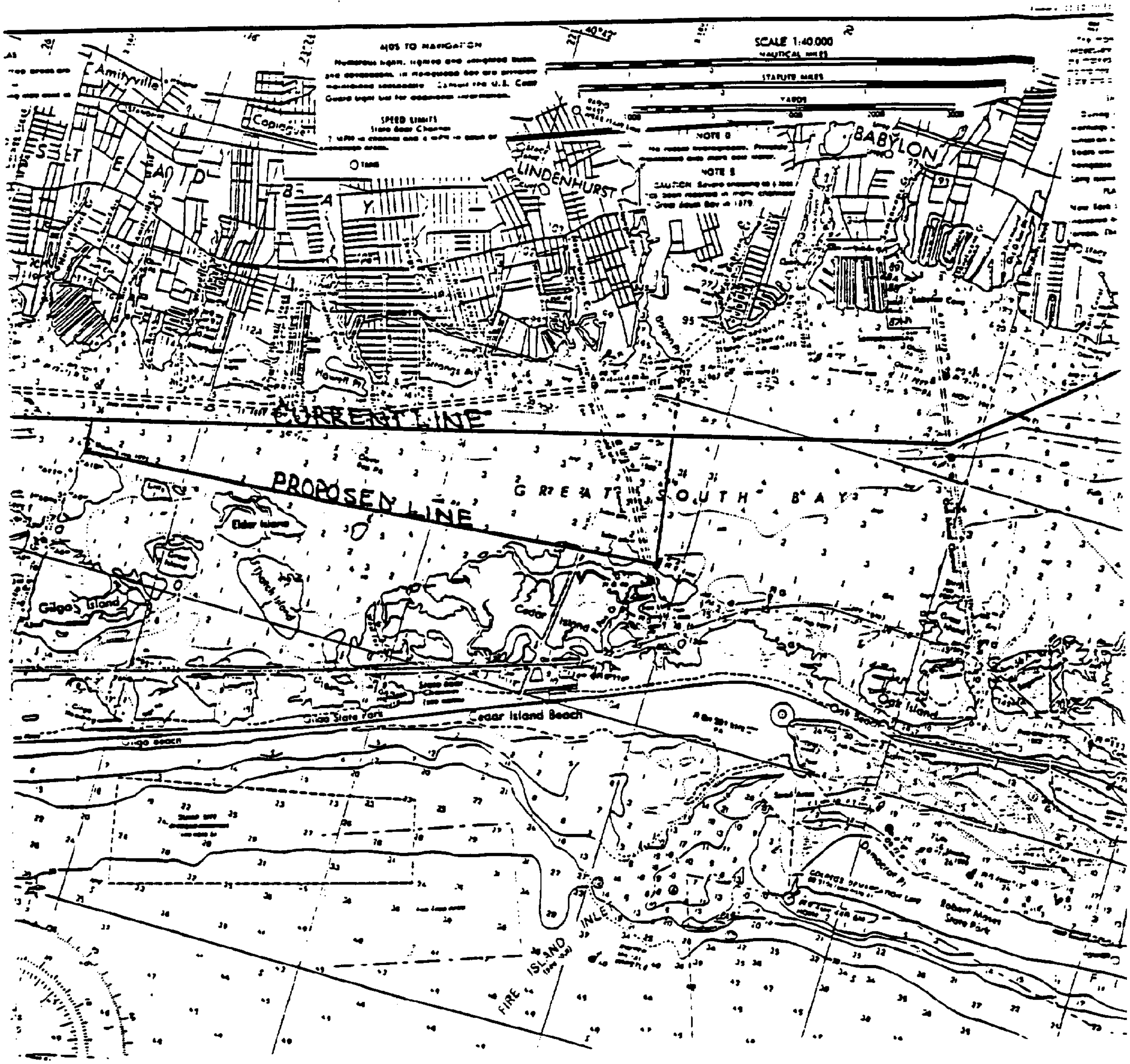
Station	# Samples	Total Coliform MPN/100ml median	% 330	Fecal Coliform MPN/100ml median	% 49
(Criteria)		(70)	(10% or less)	(14)	(10% or less)
5	14	18	0	9	14.3 *
4.1	23	23	13 *	9	8.7
59.2 **	21	9	19.4 *	7	19.4 *
55.1 **	21	43	23.8 *	9	19.4 *
54 **	23	93 *	21.7 *	15 *	30 *
50.1 **	15	150*	46.7 *	15 *	46.7 *
45 **	22	93	18.2 *	18.5*	31.8 *
41 **	24	33	25 *	16 *	12.5 *
40 **	24	23	16.7 *	9	12.5 *
40.2	13	43	15.4 *	9	7.7
34.2	23	15	4.3	9	21.7 *
34.3	23	43	13 *	4	0
20.1	30	15	6.7	7	10
20	32	12	6.3	9	6.3
19	18	15	0	8	11.1 *
22	24	43	8.3	4	12.5 *
21	8	23	0	19 *	12.5 *
23.1	22	43	4.5	9	13.6 *
20.2	28	23	7.1	9	7.1

* value exceeds criteria
** station exceeds criteria

Note: Water quality was acceptable in 1988 - 1989. Problems were noted in January - February 1990 but follow-up sampling showed an improvement in water quality. The area was found to deteriorate following heavy(2 - 2.5 inches) rain in mid-May and again on June 19 following anintense rainfall. Additional sampling sataions will be added on the proposed closure line.



Area 3. Great South Bay - Babylon



AIDS TO NAVIGATION
SCALE 1:40,000
NAUTICAL MILES
STATUTE MILES
YARDS
SPEED LIMITS
NOTE D
NOTE E
Amityville
Copiague
LINDENHURST
BABYLON
CURRENT LINE
PROPOSED LINE
GREAT SOUTH BAY
Elder Island
Gilgo Island
Cedar Island
Gilgo State Park
Cedar Island Beach
Gilgo Beach
Oak Island
Robert Moses State Park
FIRE ISLAND INLET

Summary of 1987 - 1990 Bacteriological Water Quality Sampling Data For The South Side Of The Town Of Babylon.(Does not include results from emergency sampling following rainfalls of 3 inches or greater)

Bacteriological water quality criteria are as follows:

TOTAL COLIFORM - Median total coliform MPN/100ml of 70 or less; no more than 10% of the samples at a station in excess of 330.

OR

FECAL COLIFORM - Median fecal coliform MPN/100ml of 14 or less; no more than 10% of the samples at a station in excess of 49.

Water quality at a station must meet either criteria to be acceptable.

Station	# Samples	Total Coliform MPN/100ml Median	% 330	Fecal Coliform MPN/100ml Median	% 49
6	28	23	0	9	0
6.1	22	33	9.1	8	13.6
7	22	9	0	4	4.5
7.1	28	9	0	5.5	3.6
8	22	9	0	9	0
8.1	28	12	0	7	7.1
9	22	43	0	8	0
9.1	27	23	0	9	0
10 *	22	43	22.7	23	27.3
10.1 *	28	43	10.7	23	17.9
11	22	23	0	9	4.5
11.1	28	23	3.6	15	14.3
12	11	23	0	9	4.5
12.1	10	23	0	16	0
13	14	23	0	19	14.3
14	12	41	0	16	16.7
15	6	12	0	9.5	0
16	14	23	0	23	0
17	14	41	0	33	14.3

* indicates stations that do not meet the criteria for a certified shellfish land

Note: All of the embayments along the south shore barrier beach, except Garbage Cove(stations 11 and 11.1), are designated as seasonally uncertified May15 - Sept. 30 because of the potential for contamin- from boating activity.

APPENDIX 2. CERTIFIED AREA BACTERIOLOGICAL DATA.

AREA 3 GSB-Babylon YEAR(S) 1989-1992

STATION TOTAL COLIFORM

)ATE	5	4.1	59.2	59.3	55.1	54	54.1	50.1	45	46	41	40	40.2	34.2	34.3	26	20.1	20	19	20.2	23.1	22	21		NOTE
-10-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	23	–	–	–	–	43	–	–		
-23-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9	–	–	–	–	<3	–	–		
-1-89	–	–	–	–	–	43	–	–	–	–	4	–	–	–	–	93	460	–	–	–	<3	–	–		
-16-89	–	–	–	–	–	–	–	–	–	–	4	–	–	–	23	43	43	23	–	4	7	–	–		
-7-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9	9	9	–	4	–	9	–		
-12-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	23	15	15	–	43	–	<3	–		
-13-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	43	43	<3	–	9	–	4	–		
-17-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	75	93	150	–	93	–	43	–		
-18-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	23	9	4	–	23	–	15	–		
-19-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	<3	–	–	–	–		
-3-89	23	15	43	–	43	1100	–	150	1100	–	460	<3	43	240	1100	–	1100	93	<3	150	150	150	–		
-12-89	21	93	<3	–	150	240	–	–	460	–	1100	43	<3	240	43	–	460	23	9	43	240	–	–		
-31-89	4	4	<3	–	<3	4	–	9	9	–	<3	<3	–	15	<3	–	<3	<3	<3	15	93	7	–		
-5-89	–	460	93	–	93	240	–	93	240	–	93	4	–	240	43	–	43	9	–	43	240	43	–		
-6-89	–	<3	9	–	9	240	–	43	93	–	<3	<3	–	4	<3	–	9	<3	–	<3	240	<3	–		
-7-89	–	1100	460	–	1100	1100	–	1100	240	–	1100	240	–	240	93	–	15	93	–	43	240	43	–		
-13-89	7	23	23	–	43	240	–	–	240	–	1100	43	–	–	–	–	–	–	–	–	–	–	–		xs
-14-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	43	9	4	460	–	210	–		xs
-23-89	–	–	93	–	93	–	–	–	240	–	240	240	43	–	210	–	–	240	240	240	–	93	–		xs
-24-89	43	23	–	–	–	–	–	–	–	–	150	–	23	–	–	–	–	240	15	–	–	–			
-31-89	–	93	43	–	43	7	–	9	4	–	23	–	–	7	43	7	<3	–	–	7	240	–			
-28-89	–	–	–	–	–	460	–	1100	93	–	23	–	–	93	23	240	120	240	–	43	43	460			
-6-89	–	–	–	–	93	150	–	93	93	–	23	–	–	9	4	43	15	9	–	23	15	9			
-8-89	–	–	–	–	23	75	–	93	23	–	93	–	–	15	23	9	15	9	–	23	23	4			
-10-90	93	≥2400	≥2400	–	460	240	–	460	210	–	43	1100	43	240	43	–	240	43	43	75	93	43			

)MMENT

AREA 3 GSB-Babylon YEAR(S) 1989-1992

STATION TOTAL COLIFORM

DATE	5	4.1	59.2	59.3	55.1	54	54.1	50.1	45	46	41	40	40.2	34.2	34.3	26	20.1	20	19	20.2	23.1	22	21		NOTE
1-26-90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	75	460	23	-	-	43	-		
2-6-90	93	93	1100	-	≥2400	93	-	460	460	-	240	23	9	93	460	43	43	23	9	9	43	240	43		
2-6-90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	43	4	460	-	43	-		
2-8-90	23	-	-	-	-	-	-	-	-	-	-	15	9	-	-	-	-	43	9	-	-	-	-		
2-13-90	7	43	460	-	240	1100	-	460	240	-	4	93	4	3	9	9	43	43	43	23	4	460	23		
2-21-90	-	93	93	-	93	93	-	460	1100	-	43	-	-	9	93	93	240	-	-	43	9	-	-		
2-27-90	-	23	240	93	240	150	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
3-1-90	-	23	43	7	240	43	9	23	15	<3	9	15	-	-	-	-	-	-	-	-	-	-	-		
3-8-90	4	75	23	4	23	9	<3	23	9	<3	<3	<3	<3	-	-	-	-	-	-	-	-	-	-		
3-12-90	-	23	43	15	9	9	23	9	<3	11	4	<3	-	-	-	-	-	-	-	-	-	-	-		
3-22-90	9	-	-	-	-	-	-	-	-	-	-	23	4	-	-	-	-	9	4	-	-	-	-		
3-28-90	-	23	9	-	9	7	-	4	4	-	<3	-	-	4	4	<3	43	-	-	15	4	-	-		
4-5-90	93	75	43	-	93	93	-	43	23	-	240	23	43	43	23	150	43	23	93	23	43	43	23		
5-8-90	<3	<3	<3	-	4	7	-	23	<3	-	<3	<3	9	9	9	9	<3	<3	<3	4	4	<3	<3		
5-18-90	43	93	240	-	460	240	-	1100	460	-	1100	1100	1100	1100	1100	460	93	93	93	240	150	240	240		Y.S41E4
5-31-90	9	-	-	-	-	-	-	-	-	-	-	460	43	-	-	-	-	240	75	-	-	-	-		
6-18-90	4	4	<3	-	4	4	-	9	<3	-	3	<3	4	4	3	9	4	<3	4	15	23	<3	<3		
6-19-90	9	23	210	-	150	1100	-	460	240	-	1100	1100	1100	240	93	120	93	<3	4	460	1100	3	4		
6-20-90	<3	23	<3	-	43	93	-	43	93	-	43	43	93	23	93	-	43	9	43	93	23	43	-		
6-22-90	-	-	-	-	-	-	-	-	-	-	<3	<3	23	<3	4	9	15	<3	4	4	23	4	4		
7-19-90	-	<3	<3	<3	4	<3	43	<3	<3	<3	<3	<3	9	<3	<3	4	<3	<3	-	9	23	-	-		
8-2-90	9	<3	4	4	<3	23	<3	43	23	<3	9	<3	9	9	4	-	<3	-	-	-	-	-	-		
8-26-90	23	93	93	9	93	-	14	460	≥2400	75	1100	1100	460	1100	≥2400	-	240	1100	240	460	-	240	240		>5
8-28-90	9	4	9	9	240	-	15	9	93	240	93	23	9	9	43	-	23	7	43	9	-	15	7		
9-18-90	3	9	15	4	4	4	<3	<3	15	23	15	4	9	4	14	240	23	43	4	<3	23	9	<3		

COMMENT

AREA 3 GSB-BABYLON

YEAR(S) 1989-1992

STATION

TOTAL COLIFORM

DATE	5	4.1	59.2	59.3	55.1	54	54.1	50.1	45	46	41	40	40.2	34.2	34.3	26	20.1	20	19	20.2	23.1	22	21		NOTE
10-1-90	–	43	93	9	93	93	14	21	43	43	4	23	240	23	23	93	23	<3	–	3	240	23	–		
10-2-90	43	23	21	93	4	4	<3	9	9	23	7	9	150	4	<3	23	4	<3	–	23	9	–	–		
10-15-90	43	23	43	93	93	–	240	210	240	1100	240	93	460	240	≥2400	–	240	43	75	460	–	460	240		23
10-17-90	150	20	4	15	23	–	<3	23	23	23	23	23	9	23	43	–	43	23	15	93	–	43	93		
10-24-90	240	93	43	93	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		
10-26-90	43	43	43	23	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		
11-1-90	–	–	–	–	93	43	23	43	43	23	23	23	75	7	9	9	43	23	–	240	43	14	–		
1-15-91	23	15	43	460	240	43	93	93	43	28	23	240	9	23	93	43	240	43	–	93	460	–	–		
1-29-91	150	460	23	75	240	23	23	43	9	23	4	<3	4	23	9	4	4	93	–	<3	9	–	–		
3-12-91	9	23	93	23	15	23	<3	9	7	3	43	460	9	4	23	150	240	21	–	4	<3	–	–		
3-28-91	7	43	43	39	23	9	9	4	4	4	9	75	43	23	9	23	<3	<3	–	9	9	–	–		
5-7-91	9	460	≥2400	43	240	460	9	≥2400	460	1100	≥2400	9	9	460	460	1100	240	23	9	43	93	1100	<3		
6-6-91	15	9	11	<3	9	4	<3	7	23	3	93	9	4	93	23	150	240	23	<3	9	150	<3	<3		
7-22-91	23	43	9	<3	43	9	<3	23	93	4	<3	4	23	9	4	43	<3	<3	23	9	93	4	4		
7-26-91	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–	–	<3	4	–	–	<3	<3		
9-17-91	9	4	4	21	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	9	<3	<3	<3	<3	23	23	<3		
10-17-91	23	23	23	9	93	43	21	43	15	4	4	15	9	75	7	23	9	23	<3	43	93	14	–		
10-22-91	–	15	9	23	23	23	23	23	43	39	23	9	93	<3	9	15	4	4	–	4	23	15	–		
11-1-91	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	93	43	93	43	–	–	–		23 C
11-4-91	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	240	460	1100	1100	–	–	–		<3 C
11-18-91	–	93	93	4	93	43	240	43	43	150	43	9	7	23	43	23	93	23	9	23	43	23	–		
1-16-92	210	93	240	93	240	≥2400	210	≥2400	≥2400	240	460	93	39	460	240	93	39	43	–	23	93	–	–		
1-30-92	43	75	240	240	93	43	240	39	23	240	43	43	<3	9	43	14	43	23	–	<3	9	–	–		
3-4-92	–	<3	7	<3	9	9	23	4	43	9	43	23	9	14	23	7	23	43	–	43	9	–	–		
4-1-92	–	4	3	9	15	<3	9	9	<3	4	9	75	4	15	23	<3	4	15	–	4	<3	–	–		

COMMENT

AREA 3 GSB-BABYLON

YEAR(S) 1989-1992

STATION

TOTAL COLIFORM

DATE	5	4.1	59.2	59.3	55.1	54	54.1	50.1	45	46	41	40	40.2	34.2	34.3	26	20.1	20	19	20.2	23.1	22	21		NOTE
4-15-92	–	<3	4	<3	4	15	7	9	7	<3	<3	3	23	<3	4	<3	4	<3	–	<3	9	–	–		
4-29-92	–	<3	7	<3	4	<3	4	4	<3	4	4	<3	9	4	7	3	23	<3	–	4	9	4	–		
5-11-92	<3	<3	43	<3	93	240	7	460	240	15	15	<3	9	43	93	15	15	240	9	15	43	43	9		
8-21-92	≥2400	≥2400	—	240	460	—	4	—	—	240	≥2400	460	460	≥2400	≥2400	—	≥240	1100	43	1100	—	460	240		

COMMENT

AREA 3 GSB-Babylon YEAR(S) 1989-1992

STATION FECAL COLIFORM

ATE	5	4.1	59.2	59.3	55.1	54	54.1	50.1	45	46	41	40	40.2	34.2	34.3	26	20.1	20	19	20.2	23.1	22	21		NOTE
-10-89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	-	-	-	-	43	-	-		
-23-89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	<3	-	-		
-1-89	-	-	-	-	-	43	-	-	-	-	<3	-	-	-	-	43	460	-	-	-	<3	-	-		
-16-89	-	-	-	-	-	-	-	-	-	-	4	-	-	-	23	23	43	23	-	4	<3	-	-		
-7-89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<3	<3	9	-	4	-	9	-		
-12-89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	15	15	-	23	-	<3	-		
-13-89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43	43	9	-	9	-	4	-		
-17-89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4	23	-	4	-	4	-		
-18-89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	9	4	-	23	-	15	-		
-19-89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	<3	-	-	-	-		
-3-89	23	9	23	-	4	7	-	4	14	-	23	<3	43	23	9	-	23	23	<3	43	9	<3	-		
-12-89	7	23	<3	-	150	93	-	-	23	-	43	23	<3	15	9	-	23	9	<3	43	23	-	-		
31-89	4	7	<3	-	<3	<3	-	<3	<3	-	<3	<3	-	15	<3	-	<3	<3	<3	9	23	7	-		
-5-89	-	4	23	-	4	43	-	4	43	-	43	4	-	4	<3	-	<3	9	-	9	7	<3	-		
-6-89	-	<3	4	-	4	9	-	9	7	-	<3	<3	-	4	<3	-	<3	<3	-	<3	93	<3	-		
-7-89	-	43	23	-	23	23	-	93	93	-	23	9	-	93	15	-	3	7	-	23	23	23	-		
-13-89	7	<3	<3	-	7	93	-	-	240	-	150	9	-	-	-	-	-	-	-	-	-	-	-		
-14-89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	4	4	240	-	43	-		
-23-89	-	-	43	-	T	-	-	-	93	-	23	93	23	-	150	-	-	43	93	23	-	43	-		
-24-89	7	23	-	-	-	-	-	-	-	-	20	-	23	-	-	-	-	43	<3	-	-	-	-		
-31-89	-	<3	43	-	43	7	-	9	<3	-	9	-	-	4	15	<3	<3	-	-	7	43	-	-		
-28-89	-	-	-	-	-	460	-	1100	93	-	23	-	-	43	9	93	120	43	-	43	9	460	-		
-6-89	-	-	-	-	93	93	-	93	93	-	9	-	-	9	4	43	4	9	-	23	7	4	-		
-5-89	-	-	-	-	23	75	-	93	23	-	21	-	-	15	9	9	15	9	-	23	9	4	-		
-10-90	93	≥2400	≥2400	-	460	240	-	460	120	-	43	210	43	93	43	-	93	43	43	23	43	23	-		

MMENT

AREA 3 GSB-Babylon YEAR(S) 1989-1992

STATION FECAL COLIFORM

DATE	5	4.1	59.2	59.3	55.1	54	54.1	50.1	45	46	41	40	40.2	34.2	34.3	26	20.1	20	19	20.2	23.1	22	21		NOTE
1-26-90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	75	150	23	-	-	23	-		
2-6-90	93	93	1100	-	2400	93	-	460	460	-	240	23	9	93	23	9	23	23	9	9	43	43	43		
2-6-90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	43	4	-	-	23	-		
2-8-90	23	-	-	-	-	-	-	-	-	-	-	15	9	-	-	-	-	43	9	-	-	-	-		
2-13-90	7	43	460	-	240	1100	-	460	240	-	4	93	<3	3	4	9	43	43	43	23	4	460	23		
2-21-90	-	93	23	-	93	93	-	460	1100	-	43	-	-	4	93	93	240	-	-	43	4	-	-		
2-27-90	-	23	240	93	240	150	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
3-1-90	-	4	23	7	240	43	4	23	15	<3	9	15	-	-	-	-	-	-	-	-	-	-	-		
3-8-90	4	75	23	4	23	9	<3	23	9	<3	<3	<3	<3	-	-	-	-	-	-	-	-	-	-		
3-12-90	-	23	43	15	9	4	<3	<3	<3	11	<3	<3	-	-	-	-	-	-	-	-	-	-	-		
3-22-90	9	-	-	-	-	-	-	-	-	-	-	4	4	-	-	-	-	9	4	-	-	-	-		
3-28-90	-	23	4	-	9	4	-	4	4	-	<3	-	-	<3	<3	<3	23	-	-	15	4	-	-		
4-5-90	43	23	43	-	9	15	-	15	23	-	9	23	23	43	4	43	7	4	93	23	43	4	23		
5-8-90	<3	<3	<3	-	<3	<3	-	<3	<3	-	<3	<3	4	<3	<3	<3	<3	<3	<3	<3	4	<3	<3		
5-18-90	43	23	43	-	43	240	-	93	150	-	23	43	43	93	43	43	43	93	23	240	150	21	43		
5-31-90	9	-	-	-	-	-	-	-	-	-	-	15	4	-	-	-	-	43	75	-	-	-	-		
6-18-90	4	<3	<3	-	<3	<3	-	4	<3	-	3	<3	4	4	<3	4	<3	<3	4	15	9	<3	<3		
6-19-90	4	9	75	-	43	75	-	93	93	-	460	460	460	240	4	43	9	<3	4	93	93	<3	<3		
6-20-90	<3	4	<3	-	23	23	-	15	43	-	43	43	23	23	15	-	7	9	7	43	9	43	-		
6-22-90	-	-	-	-	-	-	-	-	-	-	<3	<3	23	<3	<3	4	<3	<3	<3	4	9	4	<3		
7-19-90	-	<3	<3	<3	4	<3	23	<3	<3	<3	<3	<3	9	<3	<3	<3	<3	<3	-	9	9	-	-		
8-2-90	9	<3	4	<3	<3	9	<3	<3	4	<3	<3	<3	9	<3	<3	-	<3	-	-	-	-	-	-		
8-26-90	23	<3	23	4	9	-	4	150	93	15	93	150	150	93	43	-	93	240	43	43	-	240	93		
8-28-90	4	<3	4	<3	9	-	3	9	15	43	9	23	<3	<3	15	-	<3	<3	3	9	-	15	4		
9-18-90	<3	<3	<3	<3	<3	<3	<3	<3	4	23	4	4	4	<3	4	9	<3	<3	<3	<3	4	<3	<3		

COMMENT

AREA 3 GSB-BABYLON YEAR(S) 1989-1992

STATION FECAL COLIFORM

DATE	5	4.1	59.2	59.3	55.1	54	54.1	50.1	45	46	41	40	40.2	34.2	34.3	26	20.1	20	19	20.2	23.1	22	21		NOTE
10-1-90	-	43	43	9	43	15	3	7	23	15	4	9	240	9	<3	23	9	<3	-	4	29	9	-		
10-2-90	43	23	4	93	<3	<3	<3	4	4	<3	7	<3	150	<3	<3	4	<3	<3	-	7	4	-	-		
10-15-90	~~43~~	~~23~~	~~15~~	~~62~~	~~43~~	-	~~15~~	~~43~~	93	~~150~~	~~240~~	93	~~240~~	~~93~~	~~1100~~	-	240	~~43~~	~~75~~	~~93~~	-	~~150~~	~~43~~		
10-17-90	93	14	4	4	4	-	<3	<3	9	9	<3	9	9	9	23	-	4	23	9	15	-	15	7		
10-24-90	43	93	43	43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
10-26-90	23	23	23	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
11-1-90	-	-	-		43	43	23	43	23	23	23	23	75	7	4	<3	4	23	-	9	43	4	-		
1-15-91	23	9	<3	460	93	23	43	43	43	4	23	240	4	23	4	4	240	43	-	9	3	-	-		
1-29-91	150	460	23	75	240	23	23	23	<3	23	<3	<3	4	23	9	<3	<3	93	-	<3	4	-	-		
2-12-91	9	23	93	23	9	23	<3	9	3	<3	43	460	9	4	23	150	240	21	-	4	<3	-	-		
3-28-91	7	43	43	39	23	9	9	4	4	<3	4	75	43	23	9	<3	<3	<3	-	9	9	-	-		
5-7-91	9	240	43	<3	23	93	<3	75	93	23	460	4	4	150	23	93	43	<3	<3	43	15	240	<3		
6-6-91	15	<3	<3	<3	4	4	<3	3	<3	<3	23	4	<3	15	4	23	11	4	<3	4	75	<3	<3		
7-22-91	23	7	<3	<3	43	4	<3	9	21	<3	<3	4	23	9	<3	4	<3	<3	23	4	43	4	<3		
7-26-91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<3	<3	-	-	<3	<3		
9-17-91	9	4	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	4	23	<3		
10-17-91	23	4	4	9	9	23	<3	4	7	<3	<3	15	4	39	<3	4	4	4	<3	9	23	4	-		
10-22-91	-	15	9	23	23	<3	23	9	43	39	23	9	93	<3	<3	4	<3	4	-	4	23	<3	-		
11-1-91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	15	43	43	-	-	-		
11-4-91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	93	75	39	43	-	-	-		
11-18-91	-	93	93	4	93	43	240	43	43	150	23	4	7	9	23	9	93	23	4	9	43	9	-		
1-16-92	210	93	240	93	240	≥2400	210	≥2400	≥2400	43	460	93	23	460	93	93	39	43	-	23	93	-	-		
1-30-92	43	75	240	240	93	23	240	39	23	240	43	43	<3	4	43	14	23	23	-	<3	9	-	-		
3-4-92	-	<3	7	<3	9	4	23	4	43	9	43	23	9	9	23	4	23	43	-	15	<3	-	-		
4-1-92	-	4	3	9	15	<3	9	9	<3	4	9	75	4	15	23	<3	4	15	-	<3	<3	-	-		

COMMENT

AREA 3 GSB-BABYLON YEAR(S) 1989-1992

STATION FECAL COLIFORM

DATE	5	4.1	59.2	59.3	55.1	54	54.1	50.1	45	46	41	40	40.2	34.2	34.3	26	20.1	20	19	20.2	23.1	22	21		NOTE
4-15-92	–	<3	4	<3	<3	4	4	9	4	<3	<3	3	9	<3	4	<3	4	<3	–	<3	9	–	–		
4-29-92	–	<3	7	<3	<3	<3	<3	4	<3	4	4	<3	9	4	<3	<3	9	<3	–	<3	<3	<3	–		
5-11-92	<3	<3	4	<3	<3	<3	<3	9	4	<3	<3	<3	9	<3	<3	<3	4	<3	–	<3	9	<3	9		
8-21-91	460	460	–	43	240	–	4	–	–	93	≥2400	93	460	1100	240	–	43	150	9	460	–	93	93		

COMMENT

AREA 3 GSB-Babylon South YEAR(S) 1988 - 1992

STATION TOTAL COLIFORM

DATE	6	6.1	7	7.1	8	8.1	9	9.1	10	10.1	11	11.1	12	12.1	13	14	15	16	17		0	24	48	72	NOTE
1-22-88	43	9	9	4	11	9	15	9	15	43	43	75	43	–	<3	9	43	43	23						
1-3-88	93	–	–	15	–	93	–	39	–	240	–	43	240	43	240	–	–	–	–						
1-10-88	23	–	–	9	–	93	–	43	–	9	–	93	23	39	43	–	–	–	–						
1-30-88	43	–	–	93	–	93	–	21	–	43	–	43	43	43	93	43	93	23	43						
-19-89	7	–	–	<3	–	9	–	4	–	<3	–	4	4	7	43	–	–	–	–						
-22-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	43	–	43	43						
-23-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	43	–	23	39						
-5-89	150	43	93	240	43	9	23	43	460	1100	9	23	–	–	–	–	–	–	–		2.15	0	0	0 B	
-7-89	9	9	4	23	43	9	120	43	93	23	4	9	–	–	–	–	–	–	–		1.15	0	0	0 I	
-17-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	23	43	–	93	29						
-29-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	23	23	–	9	23		1.51	0	0	0 I	
-30-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	93	43	–	43	43						
-23-89	240'	–	–	–	·	23	–	–	–	–	–	43	–	–	23	23	–	–	–						
-24-89	15	–	–	–	–	–	–	–	–	–	–	240	–	–	20	–	–	240	–						
-2-89	–	–	–	–	·	–	–	–	–	–	·	–	·	–	–	–	–	43	240						
-10-89	–	·	–	–	–		–	–	–	–			·	·	–	75	·	43	93						
-13-89	–	–	–	–	·		–	–	–	–	·		–	–	–	–	–	23	43						
-26-90	23	–	–	23	–	43	–	23	–	21	–	23	93	23	4	–	–	–	–						
-6-90	23	–	–	9	–	210	–	9	–	<3	–	9	4	9	4	–	–	–	–						
-8-90	23	<3	9	9	<3	4	4	<3	7	4	4	9	23	11	9	<3	15	9	23						
-22-90	23	<3	<3	4	<3	4	4	<3	7	23	9	7	9	23	23	4	4	23	93						
-31-90	15	43	150	21	23	23	4	23	43	15	43	23	93	4	43	39	9	23	23						
-5-90	4	150	9	15	43	15	120	9	460	4	9	43	15	23	4	15	7	7	<3						
-26-90	93	–	–	75	–	460	–	93	–	240	–	460	240	240	240	240	240	240	460						
-28-90	23	–	–	23	–	14	–	43	–	75	–	23	15	43	9	21	9	23	75						

COMMENT

AREA 3 CSB-Babylon South YEAR(S)

STATION TOTAL COLIFORM

DATE	6	6.1	7	7.1	8	8.1	9	9.1	10	10.1	11	11.1	12	12.1	13	14	15	16	17	NOTE
8-15-90	93	–	–	43	–	93	–	240	–	1100	–	460	460	240	1100	240	1100	460	1100	
10-17-90	23	–	–	23	–	15	–	4	–	9	–	4	23	23	75	23	9	93	240	
7-26-91	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9	9	9	43	23	
8-21-91	240	≥2400	240	460	460	93	240	240	1100	1100	≥2400	≥2400	23	93	93	460	28	240	460	
9-17-91	<3	–	–	15	–	4	–	<3	–	43	–	4	43	<3	9	9	4	23	4	
10-17-91	23	–	–	9	–	23	–	<3	–	43	–	9	4	9	<3	9	23	23	23	
11-1-91	–	–	–	–	–	–	–	–	–	–	–	–	–	–	240	240	–	240	240	
11-4-91	–	–	–	–	–	–	–	–	–	–	–	–	–	–	240	23	–	240	23	
5-11-92	4	<3	4	9	4	15	7	23	4	23	9	43	7	93	9	4	<3	23	15	

COMMENT

AREA 3 GSB-Babylon South YEAR(S) 1988 - 1992

STATION FECAL COLIFORM

DATE	6	6.1	7	7.1	8	8.1	9	9.1	10	10.1	11	11.1	12	12.1	13	14	15	16	17						NOTE
1-22-88	4	9	4	4	4	9	<3	9	15	43	23	75	43	—	<3	4	43	9	23						
11-3-88	93	–	–	9	–	93	–	39	–	93	–	23	240	43	240	–	–	–	–						
1-10-88	23	–	–	9	–	43	–	43	–	9	–	93	23	39	43	–	–	–	–						
1-30-88	43	–	–	43	–	15	–	21	–	15	–	23	23	9	43	43	43	23	43						
1-19-88	7	–	–	<3	–	4	–	4	–	<3	–	4	4	7	43	–	–	–	–						
2-22-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9	–	43	43						
2-23-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	23	23						
7-5-89	9	15	43	23	43	4	11	23	460	460	9	9	–	–	–	–	–	–	–						
3-7-89	9	<3	<3	9	23	<3	11	15	15	23	4	4	–	–	–	–	–	–	–						
3-17-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9	43	–	43	43						
3-29-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	23	23	–	9	9						
3-30-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	93	240	–	4	43						
0-23-89	2.1	–	–	–	–	2.3	–	–	–	–	–	43	–	–	9	9	–	–	–						
0-29-89	4	–	–	–	–	–	–	–	–	–	–	240	–	–	20	–	–	43	–						
1-2-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	43	93						
1-10-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	75	–	43	23						
1-13-89	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	23	43						
1-26-90	23	–	–	23	–	43	–	23	–	15	–	23	93	23	4	–	–	–	–						
1-6-90	23	–	–	9	–	210	–	9	–	<3	–	4	4	4	4	–	–	–	–						
2-8-90	23	<3	<3	9	<3	<3	4	<3	4	4	4	4	23	7	9	<3	15	9	9						
3-22-90	23	<3	<3	<3	<3	4	4	<3	4	4	4	7	9	23	23	4	4	23	93						
5-31-90	<3	9	43	4	9	<3	<3	23	23	9	9	23	<3	4	15	23	4	4	9						
7-5-90	4	15	4	3	43	7	14	4	460	4	9	43	4	23	4	9	<3	<3	<3						
8-26-90	23	–	–	14	–	23	–	43	–	93	–	43	43	93	23	93	93	240	43						
3-28-90	23	–	–	4	–	7	–	15	–	75	–	9	7	4	9	6.2	9	23	9						
OMMENT			–																						

AREA 3 CSB-Babylon South   YEAR(S)

STATION   FECAL COLIFORM

DATE	6	6.1	7	7.1	8	8.1	9	9.1	10	10.1	11	11.1	12	12.1	13	14	15	16	17	NOTE
10-15-90	[illegible]	–	–	43	–	43	–	93	–	1100	–	460	150	93	120	240	460	240	460	
10-17-90	23	–	–	23	–	15	–	4	–	9	–	4	23	23	43	9	9	43	93	
7-26-91	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9	4	4	43	9	
8-21-91	[illegible]	240	43	23	150	93	43	93	150	1100	1100	1100	23	93	93	23	15	93	150	
9-17-91	<3	–	–	<3	–	4	–	<3	–	43	–	4	43	<3	<3	4	4	3	4	
10-17-91	4	–	–	4	–	23	–	<3	–	9	–	9	4	9	<3	9	23	23	23	
11-1-91	–	–	–	–	–	–	–	–	–	–	–	–	–	–	43	93	–	43	43	
11-4-91	–	–	–	–	–	–	–	–	–	–	–	–	–	–	15	23	–	93	23	
5-11-92	4	<3	<3	<3	<3	15	4	23	4	9	9	43	3	4	4	4	<3	9	15	

COMMENT

AREA 3 GSB - Babylon Conditional YEAR(S) 1988 - 1991

STATION TOTAL COLIFORM 100/ml

DATE	4	4.1	(59.1) 59	59.2	59.3	55	55.1	52	54	54.1	47.1	47	45	46	41.2	41.1	41	40	40.2	37	37.1	(37.3) 36	36.1	34.2	NOTE
-22-88	240		93			93		1100				240				1100					93	93	240		.49
-25-88	1100		460			1100		460				150				150					43	23	23		.03
-26-88	240		93			460		43				43				43					43	21	7		.03
3-1-88	-		-			-		-				-				<3					<3	9	<3		.03
3-3-88	240		23			23		93				93				23					15	15	23		.03
2-10-88	460		240			23		240				43				93					93	43	43		0
2-11-88	240		240			93		23				43				23					43	9	93		0
3-14-88	240		23			93		93				23				43					4	23	15		0
3-16-88	93		43			43		93				23				23					23	23	-		0
3-23-88	23		43			9		9				4				11					11	4	4		.04
3-29-88	7	4	23	4		4	<3	23	4	<3		-	<3	<3		-	9	9			-	-	-	9	1.31
1-19-88	23	23	23	43		23	93	23	23	75		-	15	23		-	4	11			-	-	-	4	0
1-28-88	23	9	11	7		9	9	23	<3	93		-	4	15		-	4	<3			-	-	-	<3	.66
3-2-88	<3	<3	23	4		15	9	4	43	4			93	4			9	3						39	.09
0-12-88																				150	43	43	43		.05 A
0-26-88																93				240	43	23	43		.03
1-1-88								240	150			75				23				93	23	23	23		.04, [illegible]
1-10-88	23		23			150		43								43				-	-	-	-		0
1-16-88												43				43				23	23	23	93		.25A
2-6-88	93		23			240		23				43				240				23	23	43	43		0
2-15-88								150				150				43				43	240	43	43		6" snow
1-10-89								240				93				23				75	150	39	93		.03 (.11)
1-23-89						23		11				9				43				4	43	4	43		0
3-1-89								43	43			15				9	4			4	9	4	23		.05A
3-16-89												4				4	4			4	7	<3	4		.05A

OMMENT

B - .26 Eab Townhall at 0900 [illegible]

A - [illegible]

AREA 3 GSB-Babylon Cond. YEAR(S)

STATION

TOTAL COLIFORM 100/ml

ATE	4	4.1	(59.1) 59	59.2	59.3	55	55.1	52	54	54.1	47.1	47	45	46	41.2	41.1	41	40	40.2	37	37.1	(37.3) 36	36.1	34.2	NOTE
-31-89	15	93	43	43		43	43	460	7		460	23	4		≥2400	150	23			43	43	1100	93	7	0 c
-28-89								150	460		460	150	93		43	93	23			43	43	150	240	93	.21 *melt
-6-89						460	93	43	150		43	1100	93		93	23	23			93	43	43	23	9	0
-8-89						240	23	93	75		93	150	23		460	240	93			240	240	23	43	15	0
-10-90		≥2400		≥2400			460		240				210				43	1100	43					240	.91 A
-26-90																									(.86A) .24 .10
-6-90	240	93		1100	-		≥2400		93				460			240	240	23	9					93	.15 .22 4
-13-90	240	43	-	460	-	-	240	-	1100	-	-	-	240	-	-	240	4	93	4	-				3	.23 .14 4
-21-90	43	93	23	93	-	460	93	460	93	-	93	150	1100	-	43	93	43	-	-	150	150	43	93	4	0
-27-90	.	23	-	240	93	-	240	-	150	23	-	-	-	-	-	-	-	-	-	-					.18 .18
-1-90	43	23	93	43	7	23	240	93	43	9	15	240	15	<3	23	240	9	15	-	-					0
-8-90	23	75	23	23	4	240	23	4	9	<3	4	4	9	<3	<3	4	<3	<3	<3	<3	<3				0A .06 .14
-12-90	4	23	9	43	15	43	9	23	9	23	43	-	<3	11	43	-	4	<3	-	-	-				.01 .92
28-90	7	23	4	9	-	23	9	23	7	-	<3	<3	4	-	<3	9	<3	-	-	<3	<3	23	4	4	0
-5-90	93	75	-	43	-	-	93	-	93	-	-	-	23	-	-	93	240	23	43	-	-	-	-	43	1.70
-18-90	9	9	-	15	4	-	4	-	4	<3	-	-	15	23	-	240	15	4	9	-	-	-	-	4	.12
-1-90	120	43	43	93	9	93	93	460	93	14	1100	240	43	43	460	460	4	23	240	460	240	460	150	23	.17A
2-90	15	23	21	21	93	15	4	43	4	<3	460	93	9	23	210	<3	7	9	150	460	15	150	<3	4	.17A
-1-90	43	-	43	-	-	43	93	23	43	23	43	9	43	23	240	93	23	23	75	23	15	240	93	7	0
15-91	23	15	93	43	460	93	240	240	43	93		93	43	28	210	93	23	240	9	75	93	150	75	23	2.18
-29-91	23	460	93	23	75	21	240	43	23	23	43	23	9	23	43	4	4	<3	4	43	23	23	23	23	.02
-12-91	240	23	240	93	23	460	15	240	23	<3	43	240	7	3	15	43	43	460	9	15	<3	23	9	4	0
-28-91	<3	43	4	43	39	7	23	9	9	9	240	4	4	4	23	9	9	75	43	43	23	75	15	23	.04
-3-91	23	43	150	9	9	93	9	150	9	4	75	93	93	4	460	93	240	<3	9	240	93	≥2400	43	4	0

COMMENT

AREA 3 GSB: Babylon-Cond.

YEAR(S) 1988-91

STATION — Total COLIFORM 100/ml

TE	4	4.1	59	59.2	59.3	55	55.1	52	54	54.1	47.1	47	45	46	41.2	41.1	41	40	40.2	37	37.1	36	36.1	34.2	NOTE
17-91	93	23	-	23	9	-	93	-	43	21	-	-	15	4	-	240	4	15	9	-	-	-	-	75	0,89,00
22-91	23	15	93	9	23	43	23	93	23	23	43	43	43	39	9	23	23	9	93	75	9	210	43	<3	0000
18-91	240	93	240	43	4	43	93	150	43	240	43	93	43	150	240	23	43	9	7	93	39	43	15	23	00 TT
16-92	1100	93	150	240	93	1100	240	≥2400	≥2400	210	93	460	≥2400	240	240	1100	460	93	39	93	≥2400	93	1100	460	0,10,16,0
30-92	460	75	240	240	240	460	93	23	43	240	23	4	23	240	15	9	43	43	<3	23	<3	23	4	9	0000
4-92	93	<3	240	7	<3	23	9	<3	9	23	<3	4	43	9	4	9	43	23	9	4	4	4	<3	14	0000
1-92	<3	4	<3	3	9	<3	15	4	<3	9	9	9	<3	4	7	4	9	75	4	4	4	43	4	15	0,15,00
5-92	15	<3	4	4	<3	43	4	23	15	7	15	23	7	<3	<3	4	<3	3	23	93	<3	23	4	<3	000T
14-92	<3	<3	23	7	<3	4	4	9	<3	4	9	9	<3	4	14	9	4	<3	9	7	7	20	7	4	00 41 02

MMENT

AREA 3 CSB - Babylon Cond

YEAR(S)

STATION — TOTAL COLIFORM 100/ml

TE	333	(33.1) 31.1	(34) 31.3	33.2	26.1	26	20.1	20	(24.1) 24	24.2	23.3	23	(23.2) 23.1	20.2	50*	50.1*	NOTE
22-88		1100		93	93	43			-	-	-		-		240		
5-88		460		93	93	460			23	240	21		93		93		
29-88		9		9	4	15			43	150	7		<3		93		
1-88		<3		9	9	-			4	-	-		4		-		
3-88		23		23	23	23			23	23	15		<3		43		
10-88		150		93	120	93			23	23	9		7		43		
11-88		23		4	23	23			23	9	4		11		23		
14-88		15		75	15	<3			9	4	9		4		93		
16-88		4		4	4	23			3	43	15		7		23		
23-88		3		<3	4	9			4	<3	<3		<3		43		
29-88		-	23	-	-	23	43	4	-	9	-		<3	9	-		
14-88		-	9	-	-	23	43	4	-	9	-		15	43	-		
18-88		-	<3	-	-	15	4	4	-	4	-		<3	<3	-		
2-88			<3			23	15	4		9			4	4			
12-89	43	21		150	93	3			-	-	-						
26-89	43	39		43	93	93			93	43	93	23	23				
1-89	23	4		93	23	9			23	9	240	460	43				
10-89	-	-		-	-	-			-	-	-	-	-		93		
16-88	23	43		9	23	23			23	39	23	43	43		-		
6-88	23	93		43	39	43			23	43	43	23	43		240		
15-88	43	150		39	460	9			93	75	23	93	43		240		
10-89	43	43		43	23	23			11	93	15	11	43		210		
23-89	43	15		4	15	9			<3	43	<3	9	<3		9		
1-89	23	23		23	4	93	460		<3	460	4	4	<3		43		
16-89	4	9	23	4	4	43	43	23	4	23	<3	7	7	4	4		
MENT															* OUT OF ORDER		

AREA 3 GSB - Babylon Cond YEAR(S)

STATION — TOTAL COLIFORM 100/ml

TE	33.3	(33.4) 34.1	(34) 34.3	33.2	26.1	26	20.1	20	(24.1) 24	24.2	23.3	23	(23.2) 23.1	20.2	50*	50.1*									NOTE
-31-89	460	23	43	43	43	7	<3		15	43	150	240	240	7	43	9									
28-89	93	75	23	240	93	240	120	240	93	23	23	93	43	43	460	1100									
-6-89	93	43	4	23	43	43	15	9	23	23	23	23	15	23	460	93									
-8-89	1100	240	23	23	23	9	15	9	23	23	9	240	23	23	43	93									
10-90	43						240	43					93	75		460									
26-90							75	460																	
-6-90			460			43	43	23					43	9		460									
13-90	–		9			9	43	43					4	23	–	460									
21-90	43	43	93	9	4	93	240		23	43	4	3	9	43	240	460									
27-90															–	–									
1-90															43	23									
8-90															23	23									
12-90															<3	9									
28-90	3	4	4	<3	<3	<3	43		9	<3	7	<3	4	15	7	4									
5-90	–	–	23	–	–	150	43	23	–	–	–	–	43	23	–	43									
18-90	–	–	14	–	–	240	23	43	–	–	–	–	23	<3	–	<3									
-1-90	1100	150	23	21	93	93	23	<3	93	15	15	150	240	3	460	21									
-2-90	43	4	<3	93	23	23	4	<3	43	93	43	43	9	23	23	9									
-1-90	43	23	9	23	93	9	43	23	11	7	4	43	43	240	23	43									
15-91	43	21	93	93	28	43	240	43	21	21	43	20	460*	93	240	93									
29-91	23	7	9	93	4	4	4	93	7	4	9	4	9	<3	15	43									
12-91	240	240	23	43	23	150	240	21	23	3	<3	7	<3	4	240	9									
28-91	21	4	9	93	21	23	<3	<3	93	93	43	43	9	9	4	4									
3-91	240	93	43	9	23	23	15	15	4	4	23	4	—	<3	9	150									

NMENT

* OUT OF ORDER

AREA 3 GSB - Babylon Cond   YEAR(S) 1988-91

STATION   Total COLIFORM 100/ml

ATE	333	34.1	34.3	332	26.1	26	20.1	20	24	24.2	233	23	231	20.2	50*	50.1*	NOTE
-17-91	-	-	7	-	-	23	9	23	-	-	-	-	93	43	-	43	
-22-91	9	93	9	23	15	15	4	4	93	23	9	23	23	4	43	23	
-18-91	43	9	43	15	23	23	93	23	43	9	4	23	43	23	75	43	
-16-92	93	240	240	240	240	93	39	43	43	93	93	240	93	23	1100	≥2400	
-30-92	23	23	43	23	<3	14	43	23	9	<3	<3	<3	9	<3	75	39	
-4-92	<3	<3	23	9	4	7	23	43	9	<3	9	<3	9	43	9	4	
-1-92	9	<3	23	<3	4	<3	4	15	93	23	4	9	<3	4	4	9	
-15-92	9	<3	4	7	<3	<3	4	<3	15	9	4	9	9	<3	4	9	
29-92	9	3	4	43	4	3	23	<3	9	<3	43	23	9	4	4	4	

OMMENT

APPENDIX 4. PRECIPITATION DATA

AREA 3 CSB

DATE	Amityville 0	24	48	72					Belmont 0	24	48	72		
9-22-88	0	.38	0	0					0	1.09	0	0		
10-12-88	0	0	0	.05					—	—	—	—		
10-26-88	0	.03	0	.03					—	—	—	—		
11-1-88	.04	0	0	.06					—	—	—	—		
11-3-88	.02	1.88	.04	0					—	—	—	—		
11-10-88	0	0	0	0					—	—	—	—		
11-16-88	0	0	.35	0					—	—	—	—		
11-30-88	0	.12	1.21	0					0	0	1.52	0		
12-6-88	0	0	0	0					0	0	0	0		
12-15-88	0	*	0	0	* 6" SNOW				.33	0	0	0		
1-10-89	0	.11	T	*	* 5" SNOW				0	0	.03	0		
1-23-89	0	0	0	0					0	0	0	0		
3-1-89	.05	0	.03	0					0	0	.05	.03		
3-16-89	0	0	0	.05					0	0	0	0		
4-7-89	1.00	.12	.30	.24					.09	.42	.04	.14		
4-12-89	0	0	0	.07					0	0	.07	.06		
4-13-89	0	0	0	0					0	0	0	.07		
4-17-89	.02	1.19	0	.03					0	.51	.02	0		
4-18-89	0	.02	1.19	0					0	0	.51	.02		
4-19-89	.06	0	.02	1.19					.03	0	0	.51		
5-3-89	.52	.84	0	.75					0	1.30	0	.90		
5-12-89	.04	2.05	.20	0					0	1.94	.70	0		
5-31-89	0	0	0	.44					0	0	0	0		
6-5-89	0	.27	0	.23					0	.34	0	0		
6-6-89	.48	0	.27	0					.46	0	.34	0		
6-7-89	.67	.48	0	.27					.79	.46	0	.34		
6-22-89	.60	0	0	0					0	.17	0	0		
6-23-89	0	.60	0	0					.01	0	.17	0		
7-5-89	0	0	0	0					2.45	0	0	0		
8-7-89	0	0	0	0					.19	0	0	0		
8-13-89	.58	3.03	1.08	0					.37	.76	2.65	0		
8-14-89	.12	.58	3.03	1.08					0	.37	.76	2.65		
8-17-89	.65	0	.01	.12					.20	0	.01	0		
8-29-89	.03	0	0	0					3.83	0	0	0		
8-30-89	.68	.03	0	0					.61	3.83	0	0		

COMMENT

AREA 3 GS3a

	Amityville					Belmont			
ATE	0	24	48	72		0	24	48	72
-23-89	0	0	1.12	2.45		0	.36	2.74	.64
-24-89	0	0	0	1.12		0	0	.36	2.74
-31-89	0*	0	0	0	* .25 of sample	1.00	0	0	0
-2-89	0	1.81	0	0		0	.49	0	0
-?-89	.63	0	.07	0		1.09	0	0	.06
-?-89	0	0	0	.30		.02	0	0	0
-23-89	.15	.06	.01	.25		.21	0	0	.24
2-6-89	0	0	0	0		0	0	0	0
2-8-89	0	0	0	0		0	0	0	0
-10-90	0	.91	0	0		0	.11	0	0
-26-90	.86	.07	0	.02		.06	.10	0	0
-6-90	0	.15	T .22	.03		0	0	0	0
-9-90	0	0	0			0	0	0	0
-13-90	0	0	.23	T .14		0	0	0	.04
-21-90	0	0	0	0		0	0	0	0
-27-90	0	0	* .05	.18	* 2" SNOW	0	0	0	0
-1-90	0	0	0	0		0	0	0	0
-9-90	0	0	*	0	* 1" SNOW	.06	.14	0	0
-12-90	0	0	0	0		.01	.02	0	0
-22-90	0	.44	.03	.06		0	.06	.25	0
-28-90	0	0	0	0		0	0	0	0
-5-90	0	1.12	.49	.04		0	0	1.70	0
-8-90	0	.04	.08	.91		0	0	.05	.85
18-90	.18	1.88	0	.02		.11	2.64	.31	0
31-90	.03	2.58	0	0		0	1.32	1.50	0
18-90	0	0	0	0		0	0	0	0
-19-90	.88	0	0	0		.70	0	0	0
20-90	.03	.89	0	0		0	.70	0	0
22-90	.02	0	.03	.88		.21	0	0	.70
-5-90	0	0	0	.83		0	0	0	.01
-19-90	0	0	0	0		0	0	0	0
-2-90	0	.08	0	.02		.10	.20	.10	0
-26-90	0	2.08	2.69	.05		0	0	3.81	.02
-28-90	0	0	0	2.09		0	0	0	0
18-90	0	.43	.11	.53		0	.42	0	1.10

MMENT

APPENDIX C

I. INTRODUCTION

The objective of this study is to determine if the presence of six residential communities on a series of barrier and bay islands produce measurable (significant) impacts to selected physical and ecological systems.

Figure 1 presents a location map of the study area. The six communities under study are; Oak Beach, Oak Beach Association, Gilgo Beach, West Gilgo Beach, Oak Island and Captree Island. Collectively, these six communities are usually referred to as the "Outer Beaches". These communities contain a total of 415 residences. All are under the jurisdiction of the Town Of Babylon. Most of the residences were established during the late 19th Century.

Preparatory to starting this study, a literature review was conducted to search for other studies of a similar nature. No scientific or systematic studies were uncovered with one exception. The report uncovered, a Local Waterfront Revitalization Plan (LWRP), attempted to assess environmental conditions on the Outer Beaches. Since the document was found to be plagiarized, among other faults, it was rejected by the Babylon Town Board and therefore is not considered herein.

Funding for this study was provided by the Babylon Barrier Beach Ad Hoc Committee. This Committee is a joint association of the six Outer Beach Communities. The project team assembled for this study and their specific contributions are as follows:

EEA, Inc. Prime contractor, study design, field surveys, report preparation

Greenman-Pedersen, Inc. Field assistance, graphics, report review

EcoTest Laboratories, Inc. Laboratory analyses

Applied Biostatistics Inc. Statistical analyses

Three elements of the physical and ecological environmental systems were selected for examination. These elements were:

Botany (marsh grass density)
Ornithology (bird species composition and abundance)
Hydrology (chemical composition of groundwater)

A procedure developed by Games and Howell (1976) (as cited in Rohlf and Lema, 1991) was utilized that allowed for testing differences among means without the assumption that the variances are homogeneous. The second analysis performed was a nonparametric multiple comparisons test based upon the Mann-Whitney statistics. This test has the advantage that it does not require the assumption of normality of distributions.

B. ORNITHOLOGY

The six communities and selected undisturbed areas were surveyed for birds along the barrier beach and bay islands. A total of 13 stations were examined. Six stations were in developed areas and seven in undeveloped areas. Developed areas included the communties and built-up sections of Cedar Beach Marina and Captree State Park. Figure 1 presents the areas surveyed. Trained ornithologists, amateur birders and wildlife biologists conducted the surveys. Two teams were formed in order to sample the developed and undeveloped concurrently; one team began at Captree and worked west, while the second team began the survey at Tobay (JFK Memorial Wildlife Sanctuary) and travelled east. Weather forecasts allowed the teams to pre-arrange optimal days for the birding surveys.

Binoculars were be used to aid identification of species. Birds were also identified by sound. Where possible, approximate numbers of each species sighted were recorded. The New York State Department of Environmental Conservation (NYSDEC), Endangered Species Unit, and the Significant Habitat Unit were contacted for any information concerning endangered and/or threatened species on or in the vicinity of the project area. References and field guides utilized for species identifications are presented in the Reference Section.

C. HYDROLOGY

A total of eighteen shallow wells were sampled; eight in developed areas and ten in the undeveloped areas. Samples from the developed areas were taken from existing shallow wells, most of which are used for non-potable water. In the undeveloped areas shallow wells were installed in the field under the supervision of a trained hydrogeologist. After the wells were sampled, they were removed. All of the wells drew from the "upper glacial aquifer" and varied in depth from 3 to 20 feet below grade.

All wells were sampled according to standard protocols. For example, pipes and points were pumped until acquisition of a fresh sample was assured. Samples were taken into previously prepared bottles with appropriate preservatives; they were immediately transferred to a NYS Approved laboratory for analysis. Proper documentation (e.g., chain-of-custody sheets) was maintained.

At the analytical laboratory all tests were performed according to standard methods. Specifically, the water samples were analyzed for the parameters known as the "Suffolk County Partial Chemical Analyses". This series tests for levels of 18 compounds or parameters and is recommended by the Suffolk County Department of Health for analysis of potable waters. The parameters tested are as follows:

Iron as Fe	Hardness as $CaCO_3$
Manganese as Mn	Alkalinity as total $CaCO_3$
Free CO_2	Total Dissolved Solids
Ammonia as N	Specific Conductance
Zinc as Zn	Sodium as Na
MBAS as LAS	Copper as Cu
pH	Sulfate as SO_4
Nitrate as N	Langelier Index
Chloride as Cl	Total Coliform

Raw data returned from the laboratory was collated and presented in tabular format that allowed direct comparison of reults from developed and undeveloped areas. Comparison to minimum water quality standards was made.

Statistical tests were applied to the data to determine if differences in water chemistry exist between the developed and undeveloped areas. The Mann-Whitney U-test was selected as the test statistic. In some cases, tests were not possible because much or all of the data for a specific parameter was reported as below the detection limits of the analytical procedures.

III. RESULTS

A. MARSH GRASS DENSITY

Presented on Table 1 are the raw data for the marsh grass (Spartina alterniflora) shoot counts. Inspection of the data reveals that both the lowest and highest mean densities (as expressed in numbers per $0.25m^2$) were in undeveloped areas; the developed areas had marsh grass densities in the intermediate range. The data also shows high variability within the same area. An expression of this variability is found in the standard deviations which appear to be high. The significance of these findings will be evaluated in a following (Discussion) section.

A total of 180 quadrats in six areas were examined; four of the areas were considered undeveloped and two were considered developed. For all quadrats combined, the mean number of Spartina shoots per $0.25m^2$ was 97.4. The lowest recorded density was 26 and the highest was 226. The mean density for the developed areas was

TABLE 1

RESULTS AND COMPARISON OF MARSH GRASS DENSITIES*

QUADRAT NUMBER	UNDEVELOPED AREAS				DEVELOPED AREAS	
	GILGO ISLAND	EAST ISLAND	CEDAR ISLAND	GRASS ISLAND	OAK ISLAND	CAPTREE ISLAND
1	226	179	230	86	142	87
2	132	99	111	43	75	58
3	156	128	195	88	75	68
4	112	123	148	39	99	36
5	183	113	196	65	136	51
6	153	177	180	99	55	36
7	106	176	238	56	105	92
8	88	114	167	58	73	57
9	92	188	176	46	85	110
10	122	156	189	66	69	70
11	133	130	80	71	120	42
12	64	104	148	55	133	60
13	106	98	165	92	153	69
14	102	74	67	35	142	72
15	82	114	151	44	155	49
16	75	118	126	53	123	56
17	97	68	78	31	163	84

18	142	65	159	56	143	52
19	86	53	157	26	95	58
20	116	135	157	67	122	67
21	156	186	74	29	49	88
22	79	74	71	36	67	99
23	98	180	53	49	42	76
24	84	122	55	38	74	68
25	97	128	80	38	58	84
26	136	118	85	33	65	91
27	122	160	69	47	62	88
28	97	105	40	76	41	76
29	132	96	47	51	92	64
30	169	92	35	62	55	71
SUM	3,543	3,673	3,727	1,635	2,868	2,079
STANDARD DEVIATION	35.49492	37.84854	58.68201	19.24188	37.13542	18.06128
VARIANCE	1,259.89	1,432.512	3443.578	370.25	1,379.04	326.21
MEAN	118.1	122.4333	124.2333	54.5	95.6	69.3

* Densities are expressed in numbers of plants per 0.25m^2

82.4 and for the undeveloped areas, 104.8. Figure 2 presents a frequency of occurrence plot fort he developed and undeveloped areas.

Data from the six areas studied was given to a professional biostatistics firm for review and analysis. Based upon initial, review the firm concluded, "As one would expect from even a casual examination of the data, there is not a clear one-sided difference between samples from developed and undeveloped islands" (refer to Appendix A, this report). A complete copy of the Applied Biostatistics report is found in Appendix A.

Because there was no significant difference between mean densities in the developed and undeveloped areas, tests were performed to see if the six areas were significantly different from each other. The results indicated that Grass Island was significantly different (the mean density was lower) than the other islands. Oak Island and Captree Island had the next larger means and were not significantly different from each other. The mean densities for Gilgo, East Cedar and Oak Islands were not significantly different from each other. The results of a second series of statistical tests, the Mann-Whitney tests, were similar.

B. ORNITHOLOGY

Thirteen areas were surveyed for bird species and numbers; six of the zones were in developed areas and seven were considered undeveloped. The highest number of species counted was 26 from the JFK Wildlife Sanctuary near Tobay Beach, an undeveloped area. The lowest number of species encountered was 2, also from an undeveloped area near Cedar Beach. Table 2 presents data that shows the total species sighted in developed and undeveloped areas. For the developed areas, the mean number of different species present was 10.8 and for the undeveloped areas the mean number of species was 11.3. These results are summarized as follows:

Zone	Number of Species
Developed Areas	
Oak Beach	12
Oak Beach Association	3
Captree Island	16
Captree State Park	12
Cedar Beach Marina	6
Oak Island	16
Undeveloped Areas	
JFK Wildlife Sanctuary	30
West Gilgo	7
Gilgo	7
Cedar Beach	2
Cedar Beach Overlook	7
Captree State Park	15
Captree Island	11

Figure 2. Comparison of marsh grass density in developed and undeveloped areas.

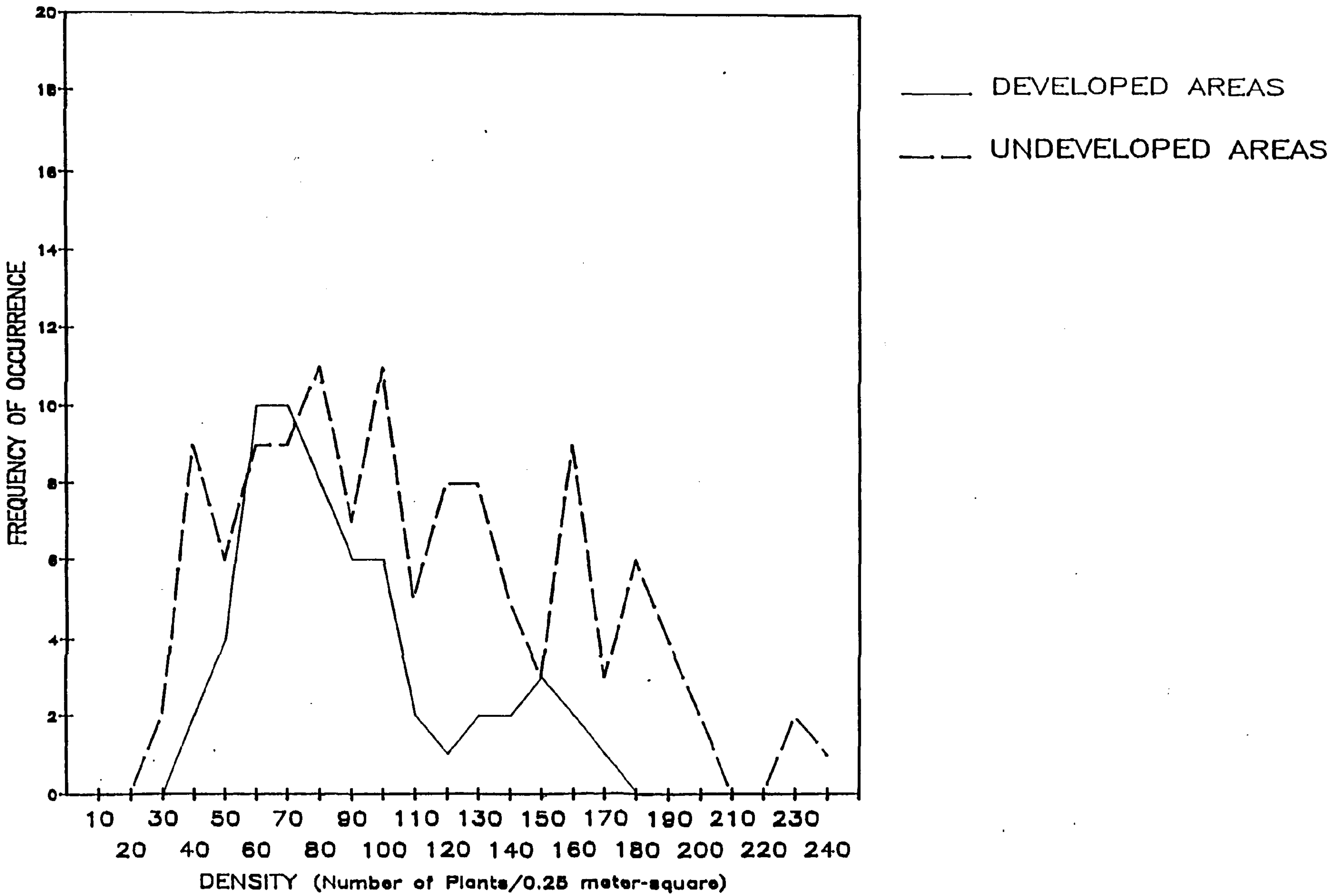


TABLE 2

INVENTORY OF AVIAN SPECIES
BARRIER BEACH STUDY

COMMON NAME	SCIENTIFIC NAME	DEVELOPED	UNDEVELOPED
American robin	Turdus migratorius	X	
Black-capped chickadee	Parus atricapillus		X
Black-crowned night heron*	Nycticorax nycticorax	X	
Black duck	Anas rubripes	X	X
Bonaparte's gull	Larus philadelphia		X
Brant	Branta bernicla	X	X
Bufflehead	Bucephala albeola	X	X
Canada geese	Branta canadensis	X	
Cardinal	Cardinalis cardinalis	X	X
Common flicker	Colaptes auratus		X
Common** or Red-throated loon	Gavia immer or G. stellata		X
Crow	Corvus sp.	X	X
Double-crested cormorant	Phalacrocorax auritus		X
Downy woodpecker	Picoides pubescens	X	X
Dunlin	Calidris alpina		X
Eastern meadowlark	Sturnella magna	X	X
European starling	Sturnus vulgaris	X	X
Gadwall	Anas strepera		X
Great blue heron	Ardea herodias		X
Greater black-backed gull	Larus marinus	X	X
Greater scaup	Aythya marila	X	X
Green-winged teal	Anas crecca		X
Herring gull	Larus argentatus	X	X
Hooded merganser	Lophodytes cucullatus	X	X
Horned grebe	Podiceps auritus		X
House finch	Carpodacus mexicanus	X	X
House sparrow	Passer domesticus	X	
Louisiana heron*	Egretta tricolor	X	X
Mallard	Anas platyrhynchos	X	X
Mockingbird	Mimus polyglottos	X	
Mourning dove	Zenaida macroura	X	X
Mute swan	Cygnus olor		X
Northern harrier**	Circus cyaneus	X	X
Northern shoveller duck	Anas clypeata		X
Pied-billed grebe	Podilymbus podiceps	X	
Pintail	Anas acuta		X
Red-breasted merganser	Mergus serrator	X	X
Red-breasted nuthatch	Sitta canadensis		X
Red-tailed hawk	Buteo jamaicensis		X
Red-winged blackbird	Agelaius phoeniceus	X	X
Ring-billed gull	Larus delawarensis	X	X
Rock dove	Columba livia	X	X
Sanderling	Calidris alba		X
Sharp-shinned hawk	Accipeter striatus		X

* NYSDEC Protected Wildlife
** NYSDEC Species of Special Concern

TABLE 2 - continued

INVENTORY OF AVIAN SPECIES
BARRIER BEACH STUDY

COMMON NAME	SCIENTIFIC NAME	DEVELOPED	UNDEVELOPED
Sharp-tailed sparrow	Ammospiza caudacuta	X	
"Slate-colored" junco	Junco hyemalis	X	
Snipe	Capella gallinago		X
Snow bunting	Plectrophenax nivalis	X	X
Song sparrow	Melospiza melodia	X	X
Tree sparrow	Spizella arborea		X
Western sandpiper	Calidris mauri	X	X
White-throated sparrow	Zonotrichia albicollis		X
Yellow-rumped warbler	Dendroica coronata	X	X

Total number of bird species sighted was 54. For all the developed areas combined, the total species number recorded was 32, and the corresponding number for the undeveloped areas was 45.

C. HYDROLOGY

Eighteen shallow wells were sampled during the study; eight from undeveloped areas and ten from developed areas. The results of the analyses (Suffolk County Partial Chemical Analyses) are presented on Tables 3 and 4. Included in these tables is a column that gives the minimum water quality standards as defined by the Department of Health. These water quality standards are for potable (drinking) water although it is recognized that few, if any, shallow wells in the developed areas are used for potable water.

Table 5 presents a comparison of each of the parameters sampled for both the developed and undeveloped areas. The results of the Mann-Whitney U-test (refer to Appendix A) show that there were significant differences in the developed and undeveloped areas for 7 parameters of the 18 tested. Eleven of the 18 parameters showed no significant differences or were indeterminate. In the undeveloped areas iron, managanese, free CO_2, and zinc were signicantly higher and pH significantly lower. In the developed areas ammonia and MBAS were significantly higher.

Where comparisons could be made to minimum water quality standards for drinking water it is obvious that most of the samples from both zones (developed and undeveloped) would meet the standards. Samples 2 and 10 from the developed areas had excessive chloride as did samples 15 and 17 from the undeveloped areas. Sodium and sulfate levels were also above standards for samples 15 and 17. Hydrogen ion concentration (pH) was beyond the acceptable range for almost all samples collected.

In summary, of the 18 parameters tested, eleven exhibited no significant difference (or were indeterminate), five showed poorer water quality in the undeveloped areas and three showed poorer quality in the developed areas.

IV. DISCUSSION

The objective of this section is to analyze and discuss the results of the various studies as presented above. Additionally, the results will be compared to other relevant programs. Finally, a summary of conclusions will be given.

A. MARSH GRASS DENSITY

Inspection of the data reveals that there is high variability in the densities of marsh grass both between study areas (of 30

TABLE 3

CHEMICAL ANALYSIS OF GROUNDWATER COLLECTED FROM DEVELOPED AREAS

ANALYTICAL PARAMETERS		STA 1	STA 2	STA 3	STA 4	STA 5	STA 6	STA 7	STA 8	STA 9	STA 10	MINIMUM WATER QUALITY STANDARDS
Iron as Fe	mg/L	1.8	0.14	0.20	<0.10	3.3	<0.10	<0.10	17	1.1	4.3	0.5
Manganese as Mn	mg/L	0.06	<0.05	0.08	<0.05	0.19	<0.05	<0.05	0.16	<0.05	<0.05	0.5
Free CO2	mg/L	20	10	10	7	21	14	10	39	18	20	---
Ammonia as N	mg/L	.015	0.31	0.39	<0.05	1.0	0.72	3.0	0.26	<0.05	0.42	10.0
Zinc as Zn	mg/L	0.16	0.43	0.03	0.21	0.27	0.04	<0.02	4.3	0.61	0.92	5.0
MBAS as LAS	mg/L	0.18	0.15	0.14	<0.1	0.11	<0.1	0.89	<0.1	<0.1	<0.2	0.5
pH units		6.7	7.5	7.5	7.5	6.5	7.3	7.5	6.7	6.4	6.0	7.5 - 8.5
Nitrate as N	mg/L	3.2	<0.5	<0.5	<0.5	2.0	<0.5	<0.5	<0.5	<0.5	<0.5	10.0
Chloride as Cl	mg/L	11	25	4000	69	31	37	32	38	26	830	250
Hardness as CaCO3	mg/L	74	190	1400	190	39	152	130	110	34	180	---
Alkalinity tot CaCO3	mg/L	50	150	220	130	30	130	150	100	24	26	---
Tot Dissolved Solids	mg/L	90	240	8000	300	120	210	200	210	110	1700	---
Spec. Cond. umho/cm	mg/L	220	490	13000	580	180	400	440	340	150	3000	---
Sodium as Na	mg/L	9.9	20	2200	42	18	16	27	13	10	270	*
Copper as Cu	mg/L	<0.05	<0.05	<0.05	<0.05	0.05	0.05	<0.05	<0.05	<0.05	<0.05	1.0
Sulfate as SO4	mg/L	16	33	430	24	7	8	14	6	18	90	250
Langelier Index		-1.8	-0.2	0.8	-0.2	-2.5	-0.5	-0.3	-1.4	-2.7	-2.5	**
T. Coliform, MPN/100mL		<2.2	<2.2	<2.2	<2.2	<2.2	2.2	<2.2	>16	5.1	<2.2	2.2

Station Locations

1 = Eagan - Oak Beach Association
2 = Morris - Oak Beach
3 = Allyn - Gilgo
4 = Howell - Gilgo
5 = Canning - Oak Beach Association

6 = Carr - Oak Beach Association
7 = Grossman - West Gilgo
8 = Tooker - Captree Island
9 = Henning (east) - Oak Island
10 = Henning (west) - Oak Island

* The NYDOH recommends that the sodium level not exceed 20 mg/l for severely restricted sodium diets and 270 mg/l for moderately restricted sodium diets.

** As close to zero as possible.

Note: Parameters that are not assigned a specific requirement are used as guidelines and indicators by the Department of Health.

TABLE 4

CHEMICAL ANALYSIS OF GROUNDWATER COLLECTED FROM UNDEVELOPED AREAS

ANALYTICAL PARAMETERS		STA 11	STA 12	STA 13	STA 14	STA 15	STA 16	STA 17	STA 18		MINIMUM WATER QUALITY STANDARDS
Iron as Fe	mg/L	16	130	43	3.6	2.2	36	7.0	15		0.5
Manganese as Mn	mg/L	0.16	0.60	0.26	0.05	0.08	0.10	0.40	0.10		0.5
Free CO2	mg/L	40	190	40	30	8	30	40	20		---
Ammonia as N	mg/L	0.29	<0.05	<0.05	0.22	<0.05	0.15	0.20	0.10		10.0
Zinc as Zn	mg/L	1.4	4.0	4.2	2.1	2.3	4.8	5.4	5.4		5.0
MBAS as LAS	mg/L	0.2	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1		0.5
pH units		6.2	4.7	6.1	7.0	7.1	5.9	5.7	6.8		7.5 - 8.5
Nitrate as N	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		10.0
Chloride as Cl	mg/L	42	57	49	210	16000	73	9900	120		250
Hardness as CaCO3	mg/L	34	110	65	160	2100	33	2200	50		---
Alkalinity tot CaCO3	mg/L	28	2	26	150	94	14	18	62		---
Tot Dissolved Solids	mg/L	80	130	170	500	32000	210	18000	340		---
Spec. Cond. umho/cm	mg/L	180	260	200	1000	44000	300	27000	430		---
Sodium as Na	mg/L	21	19	14	74	3900	27	5700	54		*
Copper as Cu	mg/L	<0.05	0.07	<0.05	<0.05	0.05	<0.05	<0.05	<0.05		1.0
Sulfate as SO4	mg/L	8	21	6	8	2000	15	1200	15		250
Langelier Index		-2.3	-5.0	-2.8	-0.8	0.2	-3.5	-1.9	-1.8		**
T. Coliform, MPN/100mL		>16	>16	>16	16	>16	>16	>16	>16		2.2

Station Locations

11 = JFK Wildlife Refuge - Tobay
12 = Gilgo State Park (east)
13 = Gilgo State Park (west)
14 = Captree Island (east side)
15 = East Fire Island
16 = Cedar Beach (southside)
17 = Cedar Beach (southside)
18 = Cedar Beach (northside)

* The NYDOH recommends that the sodium level not exceed 20 mg/l for severely restricted sodium diets and 270 mg/l for moderately restricted sodium diets.

** As close to zero as possible.

Note: Parameters that are not assigned a specific requirement are used as guidelines and indicators by the Department of Health.

TABLE 5

COMPARISON OF CHEMICAL ANALYSIS FOR GROUNDWATER SAMPLES

	IRON		MANGANESE		FREE CO2	
	DEV	UNDEV	DEV	UNDEV	DEV	UNDEV
	1.8	16	0.06	0.16	20	40
	0.14	130	<0.05	0.60	10	190
	0.20	43	0.08	0.26	10	40
	<0.10	3.6	<0.05	0.05	7	30
	3.3	2.2	0.19	0.08	21	8
	<0.10	36	<0.05	0.10	14	30
	17	7	<0.05	0.40	10	40
	1.1	15	0.16	0.10	39	20
	4.3		<0.05		18	
	<0.10		<0.05		20	
TOTAL	27.84	252.8	0.49	1.75	169	398
MEAN	2.784	31.6	0.049	0.22	16.9	49.75

	AMMONIA		ZINC		MBAS AS LAS	
	DEV	UNDEV	DEV	UNDEV	DEV	UNDEV
	0.15	0.29	0.16	1.4	0.18	0.2
	0.31	<0.05	0.43	4	0.15	<0.1
	0.39	<0.05	0.03	4.2	0.14	<0.1
	<0.05	0.22	0.21	2.1	<0.1	<0.1
	1.0	<0.05	0.27	2.3	0.11	<0.1
	0.72	0.15	0.04	4.8	<0.1	<0.1
	3	0.20	<0.02	5.4	0.89	<0.1
	0.26	0.10	4.3	5.4	<0.1	<0.1
	<0.05		0.61		<0.1	
	0.42		0.92		<0.2	
TOTAL	6.25	0.96	6.97	29.6	1.47	0.2
MEAN	0.625	0.12	0.697	3.7	0.147	0.025

	PH		NITRATE		TOT CaCo3 (ALKALINITY)	
	DEV	UNDEV	DEV	UNDEV	DEV	UNDEV
	6.7	6.2	3.2	<0.5	50	28
	7.5	4.7	<0.5	<0.5	150	2
	7.5	6.1	<0.5	<0.5	220	26
	7.5	7.0	<0.5	<0.5	130	150
	6.5	7.1	2.0	<0.5	30	94
	7.3	5.9	<0.5	<0.5	130	14
	7.5	5.7	<0.5	<0.5	150	18
	6.7	6.8	<0.5	<0.5	100	62
	6.4		<0.5		24	
	6.0		<0.5		26	
TOTAL	69.6	49.5	5.2	0	1010	394
MEAN	6.96	6.19	0.52	0	101	49.25

	CHLORIDE		CaCo3 (HARDNESS)		CONDUCTIVITY	
	DEV	UNDEV	DEV	UNDEV	DEV	UNDEV
	11	42	74	34	220	80
	25	57	190	110	490	130
	4000	49	1400	65	13000	170
	190	210	190	160	580	500
	39	16000	39	2100	180	32000
	152	73	152	33	400	210
	130	9900	130	2200	440	18000
	110	120	110	50	340	340
	34		34		150	
	180		180		3000	
TOTAL	4871	26451	2499	4752	18800	51430
MEAN	487.1	3306.38	249.9	594	1880	6428.75

	SODIUM		COPPER		SULFATE	
	DEV	UNDEV	DEV	UNDEV	DEV	UNDEV
	9.9	21	0.05	<0.05	16	8
	20	19	0.05	0.07	33	21
	2200	14	<0.05	<0.05	430	6
	42	74	<0.05	<0.05	24	8
	18	3900	<0.05	0.05	7	2000
	16	27	<0.05	<0.05	8	15
	27	5700	<0.05	<0.05	14	1200
	13	54	<0.05	<0.05	6	15
	10		<0.05		18	
	270		<0.05		90	
TOTAL	2652.9	9809	0.1	0.12	646	3273
MEAN	262.59	1226.13	0.01	0.015	64.6	409.125

	LANGELIER INDEX		T - COLIFORM	
	DEV	UNDEV	DEV	UNDEV
	-1.8	-2.3	<2.2	>16
	-0.2	-5.0	<2.2	>16
	0.8	-2.8	<2.2	>16
	-0.2	-0.8	<2.2	16
	-2.5	0.2	<2.2	>16
	-0.5	-3.5	<2.2	>16
	-0.3	-1.9	2.2	>16
	-1.4	-1.8	<2.2	
	-2.7		>16	
	-2.5		5.1	
			<2.2	
TOTAL	-11.3	-17.9	7.3	128
MEAN	-1.13	-2.24	0.73	16

quadrats) and within individual study areas. This high variation is expressed mathematically as the variance and standard deviation. When all the study areas are considered it is shown that the lowest and highest mean densities occurred in the undeveloped areas; the developed areas had intermediate densities.

There does not appear to be any statistically significant difference in marsh grass densities between the developed and undeveloped areas. Significant differences that were recorded between the six areas studied apparently result from factors unrelated to the presence or absence of residential structures. These factors may include average elevation and substrate composition.

Geomorphology (physical characteristics) of the islands may have some influence on the marsh grass densities. The three islands with the lowest grass densities (i.e., Grass, Oak and Captree) have a swale or dune complex associated with the marshes. These islands are a mix of dune and marsh. The three islands with the highest grass densities are Gilgo, East and Cedar; these three are marsh islands with little or no associated dune or swale complex.

B. ORNITHOLOGY

Results of the bird survey are not quantitative but they indicate that both the developed and undeveloped areas support a rich and diverse avifauna. Overall, more species were sighted (45) in all the total undeveloped areas than in all the total developed areas (32). However, the average number of species per individual developed area and per individual undeveloped area were quite similar (10.8, 11.3). This apparent anomaly can be explained by the large number of species recorded in the JFK Wildlife Sanctuary (30) which includes a varied habitat structure particularly attractive to birds.

Notwithstanding the above, in most cases it is impossible to precisely assign a particular species to either a developed or undeveloped area since most birds are highly mobile and the boundaries of the study areas could not be exactly defined. Habitat preference, however, is known and this seems to be shown in the sightings.

For example, "urban species" such as American robin, house sparrow and junco were found in developed areas and other species, not usually associated with human activities (e.g., gadwall, great blue heron, horned grebe) were found in undeveloped areas. This is a reasonable finding. At this point it is impossible to assign a value judgement to the relative worth of individual species. It can be concluded that both developed and undeveloped areas support substantial avifauna and that neither system seems to be degraded.

C. HYDROLOGY

Results of the hydrology survey appear conclusive. While some significant differences appeared in the various parameters there was no obvious trend. Some parameters appeared more degraded in the developed areas and some more degraded in the undeveloped areas. While there were differences, most levels were acceptable when compared to the standards. Overall, the data presented does not support a conclusion that the presence of the residences has any positive or negative impact on ground water chemical parameters as defined by the Suffolk County Partial Chemical Analyses Tests.

V. SUMMARY OF CONCLUSIONS

As a summation, the following conclusions may be drawn from the data collected and analyzed in this study:

A. Comparison of 120 marsh grass quadrats in undeveloped areas with 60 quadrats in developed areas showed no statistically significant difference in marsh grass density. Presence of adjacent residential structures does not appear to impact the grass densities either in a positive or negative manner.

B. Rich and diverse avifauna was found in both developed and undeveloped areas. Total species sighted in developed areas was 32, and in the undeveloped areas, 45. Average numbers of species sighted per transect were similar. Presence of the residences and other developments may slightly shift species composition. No judgement can be made as to the value of individual species and therefore no degradation of the avifauna is attributed to the presence of the residences.

C. Comparison of water chemistry results from developed and undeveloped areas show no overall degradation in groundwater quality due to presence of the residences.

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APPENDIX A

Statistical Analysis of Marsh Grass and Water Quality Data for Barrier Beach Study

A report prepared by

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Introduction

Statistical analyses were performed on two sets of data collected from 6 different islands (4 undeveloped and 2 developed) in the Great South Bay, Long Island, New York.

Marsh Grass Data

An analysis of the density of Marsh Grass plants is reported below. Density was measured by counting the number of plants found within a standard-sized area of $0.25m^2$. Thirty random samples of areas were taken on each island. The data (counts per standard area) are furnished in Table I (values have been sorted within each sample so their distributions can be compared).

The selection of an appropriate statistical method to test whether or not the densities of plants differ on different islands depends upon what assumptions can be made about the statistical distribution of counts of plants per standard area within each island.

It is obvious that the counts within each island are not consistent with a Poisson distribution (which would have implied that the samples were collected at random from a single homogeneous population). In samples from a Poisson distribution the means and variances are expected to be approximately equal. The fact that the variances are much larger than the means (see Table II) implies that the distribution is "clumped" or "overdispersed". Various summary statistics are also shown. The index of skewness is statistically significantly different from zero (at $P<0.05$) only for Gilgo Island. The Dmax statistic, a more powerful statistic to test for deviations from normality, was statistically significant for Cedar and Oak Islands. Descriptions of the statistics presented are given in the text *Biometry* (Sokal and Rohlf, 1981). The computer results presented are all taken from the *BIOM* package of statistical computer programs (Rohlf, 1981). Similar analyses (not shown) were also run using Box-Cox and log transformations. Very similar results were obtained indicating that transformations did not help to adjust the distribution of the data to conform to the usual assumptions of parametric tests.

The use of various transformations was also investigated in terms of its effects on the sample variances. Most statistical parametric statistical procedures assume that the variances are homogeneous. The Box-Cox transformation was investigated first since it will indicate the most appropriate transformation to use with the family of power transformation. The HOMOV program was used to find the transformation that would adjust the data so that they would both be approximately normally distributed and would have homogeneous variances. The results are shown in Table III.

As one can see from even a casual examination of the data, there is not a clear one-sided difference between samples from developed and undeveloped islands. The observed density of Marsh Grass for Grass Island (one of the undeveloped islands) was lower than that for the two developed islands. For that reason the islands were treated separately in the statistical analyses rather than pooling them into two groups — developed vs. undeveloped islands. It does not make sense to pool samples that are statistically heterogeneous. Since this decision about testing was made after examining the data, *a posteriori* (multiple comparision) tests are used below to compare samples from different islands.

In view of the lack of homogeneity of the sample variances, even after transformation, the procedure developed by Games and Howell (1976) was used. This allows one to test for differences among means without the assumption that the variances are homogeneous. It is described in Box 13.2 of *Biometry.* Since the test does assume normal distributions it was also performed using log-transformed data. The results, shown in Table IV, are very similar for both raw and for transformed data. In both cases, group 4 (Grass Island) was significantly different statistically and lower than the means from the other islands. Groups 5 and 6 (Oak Island and Captree Island, the two developed islands) had the next larger means and were not significantly different statistically from each other. For log-transformed data group 3 (Cedar Island) was also not significantly different statistically from groups 5 and 6. For both raw and log-transformed data, the means for groups 1, 2, 3, and 5 were not significantly different statistically from one another.

The last analysis performed on these data was a nonparametric multiple-comparisons test based on the Mann-Whitney statistics. It is described in Box 13.7 of *Biometry*. While it is a less powerful test than its parametric equivalents, it has the advantage that it does not require the assumption of normality of distributions. Since it is based on ranks it also is not effected by the choice of different statistical transformations of the data. The results are shown in Table V. The statistical interpretation of the results are identical to those given in Table IV A. Group 4 (Grass Island) is significantly different statistically (and lower) than the other groups. Groups 5 and 6 (Oak Island and Captree Island, the two developed islands) come next and are not significantly different statistically from each other. Finally, groups 1, 2, 3, and 5 (Gilgo, East, Cedar, and Oak Islands) are not significantly different statistically from one another.

Water Chemistry Data

A statistical analysis of 17 measures of water quality for samples of water taken on undeveloped vs. developed islands is presented below. The raw data are given in Table VI.

Since sample sizes were so small it was not possible to make effective tests for normality or for homogeneity of variances as was done for the Marsh Grass data. For this reason the data were analyzed using just the Mann-Whitney U-test (describe in Box 13.6 of *Biometry*). A summary of the results is given in Table VII. For three of the variables no test was possible due to the large number of tied values (usually due to readings below the detection limit of the test). Where tests were possible, six showed statistically significant differences. In four of the statistically significant tests the samples from developed islands had lower means than for samples taken from undeveloped islands.

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Table I. Marsh Grass Density Data sorted from high to low within each island

Undeveloped Islands				Developed Islands	
1 Gilgo	2 East	3 Cedar	4 Grass	5 Oak	6 Captree
226	188	238	99	163	110
183	186	230	92	155	99
169	180	196	88	153	92
156	179	195	86	143	91
156	177	189	76	142	88
153	176	180	71	142	88
142	160	176	67	136	87
136	156	167	66	133	84
133	135	165	65	123	84
132	130	159	62	122	76
132	128	157	58	120	76
122	128	157	56	105	72
122	123	151	56	99	71
116	122	148	55	95	70
112	118	148	53	92	69
106	118	126	51	85	68
106	114	111	49	75	68
102	114	85	47	75	67
98	113	80	46	74	64
97	105	80	44	73	60
97	104	78	43	69	58
97	99	74	39	67	58
92	98	71	38	65	57
88	96	69	38	62	56
86	92	67	36	58	52
84	74	55	35	55	51
82	74	53	33	55	49
79	68	47	31	49	42
75	65	40	29	42	36
64	53	35	26	41	36

Table II. Raw Statistics for Marsh Grass Data (BASTAT program)

Group 1. Gilgo Island

N = 30 0 CLASSES TRANSFORMATION CODE = 0
ALPHA = .050 T(ALPHA) = 2.045

	STATISTIC	STAND.ERROR	CONFIDENCE LIMITS (95.00 PER CENT)	
MEAN	118.1000000	6.591243000	104.6209000	131.5791000
MEDIAN	109.0000000	8.260804000	92.10665000	125.8933000
VAR.	1303.334483			
S	36.10172410			
V	30.56878000	4.299398000	21.77651000	39.36105000
G1	1.04727300	.42689240	.21039500	1.88415000
G2	1.32702600	.83274560	-.30548420	2.95953700
DMAX	.13124920			

Group 2, East Island

N = 30 0 CLASSES TRANSFORMATION CODE = 0
ALPHA = .050 T(ALPHA) = 2.045

	STATISTIC	STAND.ERROR	CONFIDENCE LIMITS (95.00 PER CENT)	
MEAN	122.4333000	7.028298000	108.0605000	136.8062000
MEDIAN	118.0000000	8.808565000	99.98648000	136.0135000
VAR.	1481.909195			
S	38.49557371			
V	31.44207000	4.442355000	22.35745000	40.52669000
G1	.20704260	.42689240	-.62983510	1.04392000
G2	-.77680130	.83274560	-2.40931200	.85570900
DMAX	.12208640			

Group 3. Cedar Island

N = 30 0 CLASSES TRANSFORMATION CODE = 0
ALPHA = .050 T(ALPHA) = 2.045

	STATISTIC	STAND.ERROR	CONFIDENCE LIMITS (95.00 PER CENT)	
MEAN	124.2333000	10.89698000	101.9490000	146.5177000
MEDIAN	137.0000000	13.65718000	109.0711000	164.9289000
VAR.	3562.322989			
S	59.68519907			
V	48.04282000	7.498433000	32.70853000	63.37712000
G1	.14552550	.42689240	-.69135220	.98240320
G2	-1.20851900	.83274560	-2.84102900	.42399180
DMAX	.17785150			

Group 4. Grass Island

N = 30 0 CLASSES TRANSFORMATION CODE = 0
ALPHA = .050 T(ALPHA) = 2.045

STATISTIC STAND.ERROR CONFIDENCE LIMITS

			(95.00 PER CENT)	
MEAN	54.50000000	3.573128000	47.19296000	61.80704000
MEDIAN	52.00000000	4.478201000	42.84208000	61.15792000
VAR.	383.0172414			
S	19.57082628			
V	35.90977000	5.199487000	25.27682000	46.54273000
G1	.67135640	.42689240	-.16552130	1.50823400
G2	-.27340780	.83274560	-1.90591800	1.35910200
DMAX	.10278650			

Group 5. Oak Island

N = 30 0 CLASSES TRANSFORMATION CODE = 0
ALPHA = .050 T(ALPHA) = 2.045

	STATISTIC	STAND.ERROR	CONFIDENCE LIMITS (95.00 PER CENT)	
MEAN	95.60000000	6.895876000	81.49793000	109.7021000
MEDIAN	88.50000000	8.642601000	70.82588000	106.1741000
VAR.	1426.593103			
S	37.77026745			
V	39.50865000	5.842710000	27.56030000	51.45699000
G1	.29462790	.42689240	-.54224980	1.13150600
G2	-1.29979400	.83274560	-2.93230400	.33271670
DMAX	.17392830			

Group 6. Captree Island

N = 30 0 CLASSES TRANSFORMATION CODE = 0
ALPHA = .050 T(ALPHA) = 2.045

	STATISTIC	STAND.ERROR	CONFIDENCE LIMITS (95.00 PER CENT)	
MEAN	69.30000000	3.353896000	62.44128000	76.15872000
MEDIAN	68.50000000	4.203438000	59.90397000	77.09603000
VAR.	337.4586207			
S	18.37004683			
V	26.50800000	3.654733000	19.03407000	33.98193000
G1	.11440760	.42689240	-.72247010	.95128530
G2	-.38308160	.83274560	-2.01559200	1.24942900
DMAX	.08820695			

Skewness, g1, and kurtosis, g2, were significantly different from zero only for Gilgo Island. This was also true after Box-Cox and log transformation. The DMAX test for fit to a normal distribution using an intrinsic hypothesis was significant at the $P<.05$ level for Cedar and Oak Islands. Similar results were obtained after transformation.

Table III. Results from Tests of Homogeneity of Variances (HOMOV program)

A. Untransformed data.

```
VARIANCES SORTED FROM LOW TO HIGH

GROUP     N(I)     VAR(I)
   6       30    337.4586
   4       30    383.0172
   1       30   1303.3340
   5       30   1426.5930
   2       30   1481.9090
   3       30   3562.3230

MS(WITHIN) =    1415.7730 WITH   174 DEGREES OF FREEDOM

FMAX =    10.5563** WITH PARAMETERS    6 AND    29

BARTLETT'S TEST
   X2  =       53.5943
   C   =        1.013410
   X2C =       52.8852** WITH     5 DEGREES OF FREEDOM

LOG-ANOVA

STRUCTURE OF SUBSAMPLING:

   GROUP    1, NIJ =  6  6  6  6  6
   GROUP    2, NIJ =  6  6  6  6  6
   GROUP    3, NIJ =  6  6  6  6  6
   GROUP    4, NIJ =  6  6  6  6  6
   GROUP    5, NIJ =  6  6  6  6  6
   GROUP    6, NIJ =  6  6  6  6  6

           MS        DF       F
AMONG     13.658     5     5.7756**
WITHIN     2.365    24
```

All three tests are statistically significant at the P<0.01 level. Note the strong association between the mean and the variance among the six groups.

B. Box-Cox transformation

```
BOX-COX TRANSFORMATION: LAMBDA =       -.02238
   95% CONFIDENCE LIMITS       =       -.21532        .23320
   LIKELIHOOD FN. VALUE        =   -619.9551147

      6 GROUPS, INPUT CODE =  0, TRANSFORMATION CODE = 12
                                  POWER =    -.02238

VARIANCES SORTED FROM LOW TO HIGH

GROUP     N(I)     VAR(I)
   6       30       .0000
   1       30       .0000
   2       30       .0000
   4       30       .0001
   5       30       .0001
   3       30       .0001

MS(WITHIN) =         .0001 WITH   174 DEGREES OF FREEDOM

FMAX =     3.7792** WITH PARAMETERS    6 AND    29
```

```
BARTLETT'S TEST
   X2  =      19.7774
   C   =       1.013410
   X2C =      19.5157** WITH    5 DEGREES OF FREEDOM

LOG-ANOVA

STRUCTURE OF SUBSAMPLING:

   GROUP    1, NIJ =  6   6   6   6   6
   GROUP    2, NIJ =  6   6   6   6   6
   GROUP    3, NIJ =  6   6   6   6   6
   GROUP    4, NIJ =  6   6   6   6   6
   GROUP    5, NIJ =  6   6   6   6   6
   GROUP    6, NIJ =  6   6   6   6   6

            MS       DF        F
AMONG       3.001    5      1.0863 n.s.
WITHIN      2.763   24
```

The Fmax and Bartlett's tests are significant and log-anova is not significant. The Box-Cox parameter is close to zero (and is not significantly different from zero). This suggests the use of the log transformation.

C. Log transformation.

```
VARIANCES SORTED FROM LOW TO HIGH

GROUP      N(I)      VAR(I)
  6         30        .0792
  1         30        .0844
  2         30        .1120
  4         30        .1274
  5         30        .1718
  3         30        .3051

MS(WITHIN) =         .1466 WITH  174 DEGREES OF FREEDOM

FMAX =     3.8540** WITH PARAMETERS    6 AND    29

BARTLETT'S TEST
   X2  =      19.9614
   C   =       1.013410
   X2C =      19.6972** WITH    5 DEGREES OF FREEDOM

LOG-ANOVA

STRUCTURE OF SUBSAMPLING:

   GROUP    1, NIJ =  6   6   6   6   6
   GROUP    2, NIJ =  6   6   6   6   6
   GROUP    3, NIJ =  6   6   6   6   6
   GROUP    4, NIJ =  6   6   6   6   6
   GROUP    5, NIJ =  6   6   6   6   6
   GROUP    6, NIJ =  6   6   6   6   6

            MS       DF        F
AMONG       3.000    5      1.1025 n.s.
WITHIN      2.721   24
```

Results are similar to those for the Box-Cox transformation: Fmax and Bartlett's tests are significant and log-anova is not significant.

Table IV, Results of Games & Howell test for equality of means when the variances are heterogeneous (MCHETV program).

A. Untransformed data

```
      6 GROUPS, INPUT CODE =  0, TRANSFORMATION CODE =  0
                                 POWER =    1.00000
 MEANS SORTED FROM LOW TO HIGH

 GROUP     N(I)     YBAR(I)     VAR(I)
    4       30       54.5000    383.0172
    6       30       69.3000    337.4586
    5       30       95.6000   1426.5930
    1       30      118.1000   1303.3340
    2       30      122.4333   1481.9090
    3       30      124.2333   3562.3230

 -------------- TESTS AMONG ALL PAIRS OF MEANS --------------
 GROUP
  4 VERSUS:
    GROUPS          6.           5.           1.           2.           3.
    DIFF :     14.80000     41.10000     63.60000     67.93333     69.73333
    G & H:        3.020        5.292        8.483        8.616        6.081
    DF*  :       57.77        43.53        44.69        43.05        35.16

  6 VERSUS:
    GROUPS          5.           1.           2.           3.
    DIFF :     26.30000     48.80000     53.13333     54.93333
    G & H:        3.430        6.599        6.823        4.818
    DF*  :       41.99        43.07        41.56        34.45

  5 VERSUS:
    GROUPS          1.           2.           3.
    DIFF :     22.50000     26.83334     28.63333
    G & H:        2.359        2.725        2.220
    DF*  :       57.88        57.98        49.02

  1 VERSUS:
    GROUPS          2.           3.
    DIFF :      4.33334      6.13333
    G & H:         .450         .482
    DF*  :       57.76        47.72

  2 VERSUS:
    GROUPS          3.
    DIFF :      1.80000
    G & H:         .139
    DF*  :       49.57
```

G&H values > 5.1 are significant at the P<0.01 level.

B. Log-transformed data

```
      6 GROUPS, INPUT CODE =  0, TRANSFORMATION CODE =  5
                                 POWER =    1.00000
 MEANS SORTED FROM LOW TO HIGH
 GROUP     N(I)     YBAR(I)       VAR(I)
    4       30       3.9369        .1274
    6       30       4.2020        .0792
    5       30       4.4801        .1718
    3       30       4.6890        .3051
    1       30       4.7297        .0844
    2       30       4.7562        .1120
```

```
--------------- TESTS AMONG ALL PAIRS OF MEANS --------------
GROUP
 4 VERSUS:
   GROUPS        6.           5.           3.           1.           2.
   DIFF :     .26506       .54321       .75208       .79282       .81925
   G & H:      3.195        5.440        6.264        9.437        9.172
   DF*  :     55.00        56.75        49.62        55.70        57.76

 6 VERSUS:
   GROUPS        5.           3.           1.           2.
   DIFF :     .27815       .48703       .52776       .55419
   G & H:      3.041        4.303        7.148        6.943
   DF*  :     51.05        43.10        57.94        56.34

 5 VERSUS:
   GROUPS        3.           1.           2.
   DIFF :     .20888       .24961       .27604
   G & H:      1.657        2.701        2.838
   DF*  :     53.80        51.95        55.53

 3 VERSUS:
   GROUPS        1.           2.
   DIFF :     .04073       .06716
   G & H:       .357         .570
   DF*  :     43.90        47.76

 1 VERSUS:
   GROUPS        2.
   DIFF :     .02643
   G & H:       .327
   DF*  :     56.88
```

G&H values > 5.1 are significant at the $P<0.01$ level.

Table V. Results of nonparametric multiple comparison test based on Mann-Whitney statistic.

Mann-Whitney U statistics for all pairs of groups. Values are shown arrayed in order of the size of their sample mean.

	4	6	5	1	2	3
4	x					
6	650*	x				
5	746.5**	622	x			
1	862.5**	819**	601	x		
2	857**	810**	610	490	x	
3	769**	677.5*	584	461	452.5	x

Sample U values larger than their critical values ($U_{.05} = 642.75$, $U_{.01} = 677.52$) are statistically significant. Group 4 is different (and lower) from the others, groups 5 and 6 do not differ, and groups 1, 2, 3, and 5 are also homogeneous.

Table VI. Results of chemical analyses for groundwater samples.

	IRON		MANGANESE		FREE CO2	
	Devel.	Undevel.	Devel.	Undevel.	Devel.	Undevel.
	1.8	16	0.06	0.16	20	40
	0.14	130	<0.05	0.60	10	190
	0.20	43	0.08	0.26	10	40
	<0.10	3.6	<0.05	0.05	7	30
	3.3	2.2	0.19	0.08	21	8
	<0.10	36	<0.05	0.10	14	30
	17	7	<0.05	0.40	10	40
	1.1	15	0.16	0.10	39	20
	4.3		<0.05		18	
	<0.10		<0.05		20	
MEAN	2.784	31.6	0.049	0.22	16.9	49.75

	AMMONIA		ZINC		MBAS AS LAS	
	Devel.	Undevel.	Devel.	Undevel.	Devel.	Undevel.
	0.15	0.29	0.16	1.4	0.18	0.2
	0.31	<0.05	0.43	4	0.15	<0.1
	0.39	<0.05	0.03	4.2	0.14	<0.1
	<0.05	0.22	0.21	2.1	<0.1	<0.1
	1.0	<0.05	0.27	2.3	0.11	<0.1
	0.72	0.15	0.04	4.8	<0.1	<0.1
	3	0.20	<0.02	5.4	0.89	<0.1
	0.26	0.10	4.3	5.4	<0.1	<0.1
	<0.05		0.61		<0.1	
	0.42		0.92		<0.2	
MEAN	0.625	0.12	0.697	3.7	0.147	0.025

	PH		NITRATE		TOT CaCo3 (ALKALINITY)	
	Devel.	Undevel.	Devel.	Undevel.	Devel.	Undevel.
	6.7	6.2	3.2	<0.5	50	28
	7.5	4.7	<0.5	<0.5	150	2
	7.5	6.1	<0.5	<0.5	220	26
	7.5	7.0	<0.5	<0.5	130	150
	6.5	7.1	2.0	<0.5	30	94
	7.3	5.9	<0.5	<0.5	130	14
	7.5	5.7	<0.5	<0.5	150	18
	6.7	6.8	<0.5	<0.5	100	62
	6.4		<0.5		24	
	6.0		<0.5		26	
MEAN	6.96	6.19	0.52	0	101	49.25

	CHLORIDE		CaCo3 (HARDNESS)		CONDUCTIVITY	
	Devel.	Undevel.	Devel.	Undevel.	Devel.	Undevel.
	11	42	74	34	220	80
	25	57	190	110	490	130
	4000	49	1400	65	13000	170
	190	210	190	160	580	500
	39	16000	39	2100	180	32000
	152	73	152	33	400	210
	130	9900	130	2200	440	18000
	110	120	110	50	340	340
	34		34		150	
	180		180		3000	
MEAN	487.1	3306.38	249.9	594	1880	6428.75

	SODIUM		COPPER		SULFATE	
	Devel.	Undevel.	Devel.	Undevel.	Devel.	Undevel.
	9.9	21	0.05	<0.05	16	8
	20	19	0.05	0.07	33	21
	2200	14	<0.05	<0.05	430	6
	42	74	<0.05	<0.05	24	8
	18	3900	<0.05	0.05	7	2000
	16	27	<0.05	<0.05	8	15
	27	5700	<0.05	<0.05	14	1200
	13	54	<0.05	<0.05	6	15
	10		<0.05		18	
	270		<0.05		90	
MEAN	262.59	1226.13	0.01	0.015	64.6	409.125

	LANGELIER INDEX		T - COLIFORM	
	Devel.	Undevel.	Devel.	Undevel.
	-1.8	-2.3	<2.2	>16
	-0.2	-5.0	<2.2	>16
	0.8	-2.8	<2.2	>16
	-0.2	-0.8	<2.2	16
	-2.5	0.2	<2.2	>16
	-0.5	-3.5	<2.2	>16
	-0.3	-1.9	2.2	>16
	-1.4	-1.8	<2.2	
	-2.7		>16	
	-2.5		5.1	
			<2.2	
MEAN	-1.13	-2.24	?	?

Table VII. Results of Mann-Whitney U-tests for the difference between water quality parameters in water samples from developed and undeveloped islands.

Assay	Devl. - Undevel.	U	P, Comments
IRON	<	72	<0.01
MANGANESE	<	68	<0.05
FREE CO2	<	66	<0.05
AMMONIA	>	62.5	<0.05
ZINC	<	75	<0.002
MBAS AS LAS	(>)	57	ns
pH	>	63	=0.05
NITRATE	(>)	N/A	Too many ties
ALKALINITY(CaCO3)	(>)	60.5	<0.1
CHLORIDE	(<)	50	ns
HARDNESS	(<)	46	ns
CONDUCTIVITY	(<)	46.5	ns
SODIUM	(<)	56.5	ns
COPPER	(?)	N/A	Too many ties
SULFATE	(<)	40.5	ns
LANGELIER I.	(<)	56.5	ns
BACTERIA	<	N/A	Too many ties, but the trend is clear

Symbols in the Developed - Undeveloped column indicate the direction of the difference between the means. Symbols are given in parentheses if the difference is not statistically significant at the P = 0.05 level.

The symbol N/A in the column giving the sample U values indicates that no analysis was performed due to the large number of tied values (usually reading below the detection limit).

The two-tailed critical values for the U test, with $n_1 = 10$ and $n_2=8$ are: $U_{.1} = 60$, $U_{.05} = 63$, $U_{.01} = 69$, and $U_{.002} = 74$.

Spartina alterniflora
Biomass Study of the
Babylon Outer Beach Communities

Prepared for:

Babylon Barrier Beach Ad Hoc Committee
Oak Beach, New York

Prepared by:

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Kathleen Durante, M.S

November 1992

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I. Introduction

The objective of this study was to determine if the presence of six residential communities on a series of barrier and bay islands produce measurable impacts to the botany ecological system, by studying salt marsh cord grass (Spartina alterniflora).

These six communities are: Oak Beach, Oak Beach Association, Gilgo Beach, West Gilgo Beach, Oak Island and Captree Island. These communities are often referred to as the "Outer Beaches" (see Figure 1). These communities contain over 400 residences, most of which were built during the late 19th Century. All of these residences fall under the jurisdiction of the Town of Babylon.

The six areas chosen for study include two developed areas (Oak Island, and Captree Island), and four undeveloped areas (Gilgo Island, East Island, Cedar Island, and Grass Island).

A study addressing these "outer beaches" was conducted by EEA, Inc. in December of 1990. In 1985, EEA, Inc. conducted a similar wetlands study in Staten Island, New York. These studies will be included in our library of references.

The botany study was accomplished via a study of marsh grass biomass. Measurements and observations in both developed and undeveloped areas were undertaken to determine if any impacts exist due to the adjacent residences. Data collected from these study areas was compared. If environmental impacts do exist due to these residences, then the marsh grass biomass values in the developed areas (those with residences) should show evidence of degradation compared to the marsh grass biomass values in undeveloped areas. If no measurable significance can be obtained from this data, then it may be concluded that no significant impacts are occurring due to the parameters studied.

The botany (marsh grass) study is quantitative in nature because the biomass was directly measured. The data obtained using this gathering technique can therefore be used effectively for direct comparison of developed and undeveloped areas.

Tidal wetlands are important for biological and physical reasons. They are invaluable resources for flood protection, wildlife habitat, open space and water resources. These areas are

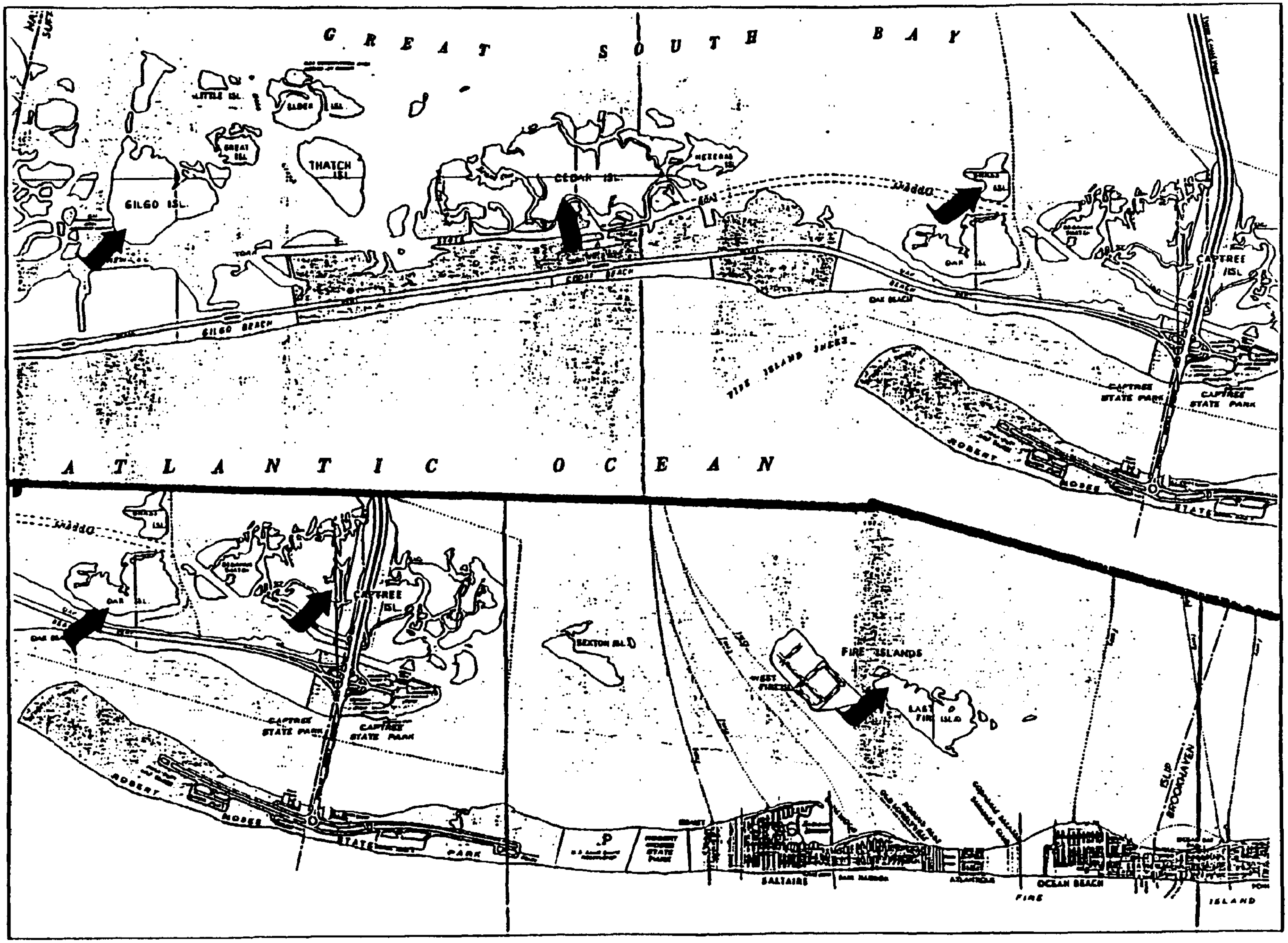

Figure 1- Study Area Map Location

flushing action of the tide together with the marsh grass serve to act as a filtration system, taking up pollutants and toxins from the sediments and water. These wetlands also act as a barrier to guard against the erosive action of the waves by absorbing most of the waves' energy.

II. Methodologies

Saltmarsh cordgrass (Spartina alterniflora) is an accepted environmental indicator of the overall health of a saltmarsh. The biomass of this species was measured in two developed areas (Oak Island, and Captree Island), and four undeveloped areas (Gilgo Island, East Island, Cedar Island, and Grass Island).

Spartina a. blooms in late June, so the first round of sampling was conducted during this time period (June/July 1991). A second round of sampling was conducted during September 1991, when the marsh grass was in its seeding stage.

In each round of sampling, a total of 30 quadrats were taken at each of the six areas (three transects of 10 quadrats each). Therefore, a total of 360 quadrats (samples) were taken during this study.

Samples were obtained by tossing a .25 m^2 hoop in randomly chosen locations within each study area. The biomass of the marsh grass of each quadrat (sample) was determined by removing the plant material within the randomly tossed hoop, and returning it to the laboratory. It was then rinsed in fresh water and dried at 60 degrees C for 24 hours. The dry plant material for each quadrat was weighed, and the value recorded. The dried weight and density constitute the biomass (g dry weight/m^2).

Averages (mean) for each of the six areas were calculated from the data, for a total of 12 area averages for the two sampling rounds (see Table 3).

The standard deviations (s.d.) were calculated using the following formula:

$$\text{s.d.} = \sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}}$$

where n = 30 (the number of samples taken at each island for each sampling period)

x^2 = the sum of the squared score values

$(\Sigma x)^2$ = the square of the sum of all the scores

This formula was taken from Computational Handbook of Statistics, 2nd Edition; James L. Bruning, B.L. Kintz Scott; Foresman and Company, Glenview, Ill., 1977.

The variance was obtained by squaring the standard deviation.

III. Results

The raw data of the weights of the marsh grass (<u>Spartina alterniflora</u>) is presented in Table 1 for the June/July sampling period, and in Table 2 for the September sampling period, including the sum for all quadrats in each sampling area, the mean weight values, the standard deviation, and the variance.

A total of 360 quadrats from the six areas were examined: 180 for the June/July sampling period, and 180 for the September sampling period. A total of 120 quadrats were taken from developed areas and 240 quadrats were taken from undeveloped areas.

Table 3 presents the average (mean) weight value for each of the six study areas for both the June/July and the September sampling periods. From this representation, it can be seen that the lowest mean weight values (137.37 and 173.00) for both sampling periods were observed at Gilgo Island (undeveloped area), while the sample areas with the highest mean weight values (191.57 and 236.27) were observed at Cedar Island (undeveloped) in June/July, and Oak Island (developed) in September. The mean weight value for the two developed areas and the four undeveloped areas is as follows:

<u>June/July Sampling Period</u>

Developed areas = 163.73
Undeveloped areas = 170.17

<u>September Sampling Period</u>

Developed areas = 211.20
Undeveloped areas = 201.28

These results do not indicate a significant difference in average (mean) weights between the developed and undeveloped islands.

This data however shows some degree of variability of weight values both within and between each sampling area during both the June/July and September sampling periods, as indicated by the standard deviations which are high. The significance of this observation will be discussed in the following section.

Table 1

Marsh Grass Weights* and Comparison of Developed and Undeveloped Areas
(June/July Sampling Period)

	Developed Areas		Undeveloped Areas			
Quadrat Number	Oak Island	Captree Island	Cedar Island	Grass Island	East Island	Gilgo Island
A-1	147	156	183	195	205	110
A-2	186	175	174	247	208	101
A-3	177	168	184	315	200	121
A-4	155	160	150	191	272	136
A-5	169	227	207	209	282	118
A-6	150	224	169	207	195	154
A-7	145	133	165	174	194	145
A-8	214	171	162	206	228	123
A-9	158	148	219	158	230	131
A-10	112	222	145	237	224	144
B-1	146	177	278	114	209	152
B-2	203	145	201	141	273	126
B-3	157	149	222	108	165	176
B-4	194	151	243	145	163	199
B-5	155	158	213	120	169	158

B-6	165	164	188	129	188	161
B-7	182	159	235	93	202	182
B-8	224	184	148	141	125	181
B-9	220	158	224	119	118	180
B-10	205	160	205	157	211	167
C-1	155	190	175	149	152	129
C-2	176	201	147	196	175	113
C-3	155	119	195	177	159	118
C-4	119	127	167	192	198	103
C-5	101	147	141	137	176	121
C-6	146	169	248	159	145	111
C-7	170	124	172	220	172	110
C-8	195	111	235	120	155	104
C-9	192	107	127	137	154	100
C-10	147	120	80	178	200	120
Sum	5020	4804	5602	5071	5747	4121
Standard Deviation	30.41249	31.48698	41.86920	48.42590	40.21810	23.39906
Variance	924.920	991.430	1753.030	2345.068	1617.496	547.516
Mean	167.33	160.13	186.73	169.03	191.57	137.37

* Weight values are in grams

Table 2

Marsh Grass Weights* and Comparison of Developed and Undeveloped Areas
(September Sampling Period)

	Developed Areas		Undeveloped Areas			
Quadrat Number	Oak Island	Captree Island	Cedar Island	Grass Island	East Island	Gilgo Island
A-1	194	220	228	204	121	107
A-2	222	137	209	181	207	174
A-3	301	135	244	236	176	153
A-4	248	199	223	252	184	199
A-5	243	192	196	248	174	169
A-6	172	155	191	167	158	142
A-7	195	149	204	192	217	199
A-8	190	134	307	243	151	179
A-9	165	146	174	234	156	127
A-10	241	123	250	266	183	138
B-1	295	168	119	195	192	281
B-2	220	189	187	177	226	159
B-3	185	187	150	238	226	152
B-4	228	211	262	196	215	220
B-5	143	228	245	69	207	195

B-6	347	189	235	202	234	177
B-7	187	209	153	291	189	239
B-8	209	212	188	130	195	176
B-9	352	256	258	121	213	164
B-10	250	211	290	125	194	144
C-1	276	253	218	325	232	200
C-2	240	195	290	219	224	153
C-3	298	165	222	235	274	209
C-4	332	156	238	171	267	224
C-5	197	142	243	227	219	257
C-6	201	181	181	249	223	128
C-7	282	204	255	127	234	143
C-8	203	217	206	183	290	138
C-9	269	219	255	257	212	114
C-10	203	202	156	162	272	130
Sum	7088	5584	6577	6122	6265	5190
Standard Deviation	54.54952	35.68515	44.60376	55.83778	38.22446	42.47596
Variance	2975.651	1273.430	1989.495	3117.857	1461.109	1804.207
Mean	236.27	186.13	219.23	204.07	208.83	173.0

* Weight values are in grams

Table 3

Average Marsh Grass Weight Values* for Each Sampling Area for Each Sampling Period

Sampling Area	Developed/ Undeveloped	Average Weight (g)- June/July	Average Weight (g)- September
Oak Island	Developed	167.33	236.27
Captree Island	Developed	160.13	186.13
Cedar Island	Undeveloped	186.73	219.23
Grass Island	Undeveloped	169.03	204.07
East Island	Undeveloped	191.57	208.83
Gilgo Island	Undeveloped	137.37	173.0

* Weight values are in grams

IV. DISCUSSION

Upon review of the data obtained, it does not seem evident that any significant differences exist between marsh grass biomass on developed islands as compared with undeveloped islands. The lowest mean weight values occurred in the undeveloped areas for both sampling periods, and the highest mean weight values occurred in the undeveloped areas during the June/July sampling period, and in the developed areas during the September sampling period.

There is some degree of variance both between and within individual sample areas, as expressed by the standard deviation and variance values. This variance, however, does not seem to be related to the presence or absence of residential structures, and may be explained by various other factors including physical characteristics of the islands, including average elevation, substrate composition, and location.

V. SUMMARY AND CONCLUSIONS

Upon comparison of 120 quadrats taken from developed areas and 240 quadrats taken from undeveloped areas, it appears that no significant differences exist between the two with regard to marsh grass biomass. Thus, the research conducted indicates no evidence of significant environmental impact (either positively or negatively) from adjacent residential structures on the marsh grass in these areas.

REFERENCES

Bruning, James L., B. Scott, Computational Handbook of Statistics, 2nd Edition, Foresman and Company, Glenview, Ill., 1977.

Energy and Environmental Analysts, Inc. "Environmental Assessment of the Babylon Outer Beach Communities", January, 1991.

Energy and Environmental Analysts, Inc. "Wetlands Ecological Studies- West Side Project Staten Island Corporate Park", January, 1986.

ENVIRONMENTAL ASSESSMENT
OF THE BABYLON
OUTER BEACH COMMUNITIES

Prepared For:

BABYLON BARRIER BEACH AD HOC COMMITTEE
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JANUARY, 1991

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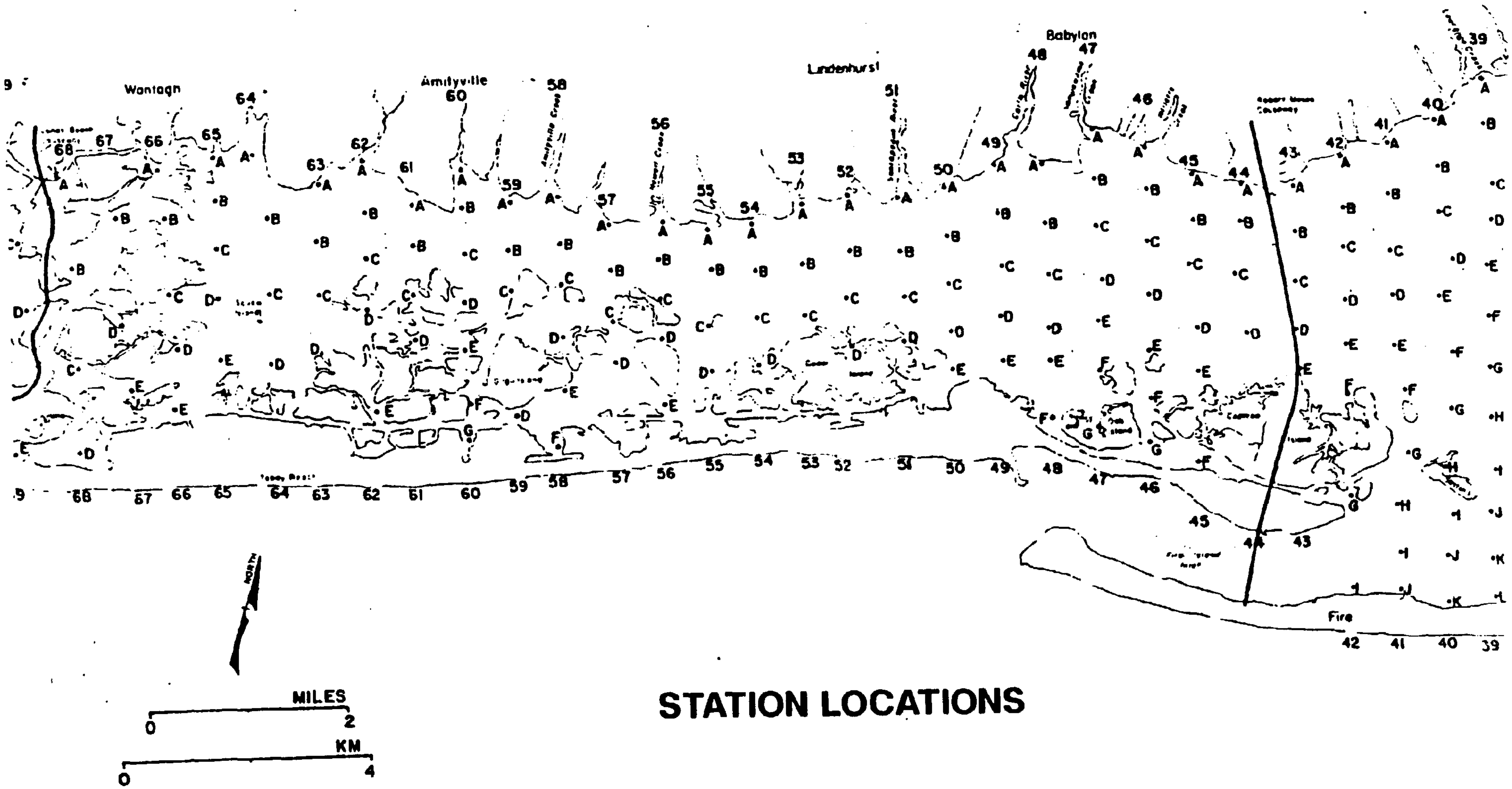


STATION LOCATIONS

SOURCE: GREENE, HARD CLAMS, COMPETITORS, PREDATORS, AND PHYSICAL PARAMETERS IN GREAT SOUTH BAY, U.S. E.P.A. CONTRACT NO 68-01-4616

DREDGED SAMPLE VARIABLES

Code	Name
A.PUNCTOSTRIATUS	*Acteon punctostriatus*
A.IRRADIANS	*Aequipecten irradians*
A.ELEVATA	*Aligena elevata*
A.AVARA	*Anachis avara*
A.TRANSVERSA	*Anadara transversa*
A.LENTUS	*Anoplodactylus lentus*
A.FORBESI	*Asterias forbesi*
B.BALANOIDES	*Balanus balanoides*
B.ALTERNATUM	*Bittium alternatum*
B.CANALICULATUM	*Busycon canaliculatum*
B.CARICA	*Busycon carica*
C.IRRORATUS	*Cancer irroratus*
C.CONVEXA	*Crepidula convexa*
C.PLANA	*Crepidula plana*
E.DIRECTUS	*Ensis directus*
E.RUPICOLA	*Epitonium rupicola*
E.CAUDATA	*Eupleura caudata*
G.GEMMA	*Gemma gemma*
H.SOLITARIA	*Haminoea solitaria*
H.TOTTENI	*Hydrobia totteni*
L.DUBIA	*Libinia dubia*
L.VINCTA	*Lacuna vincta*
L.MORTONI	*Laevicardium mortoni*
L.POLYPHEMUS	*Limulus polyphemus*
L.LITTOREA	*Littorina littorea*
L.HYALINA	*Lyonsia hyalina*
M.BALTHICA	*Macoma balthica*
M.TENTA	*Macoma tenta*
M.BIDENTATUS	*Melampus bidentatus*
M.MERCENARIA	*Mercenaria mercenaria*
M.LUNATA	*Mitrella lunata*
M.MANHATTENSIS	*Mogula manhattensis*
M.LATERALIS	*Mulinia lateralis*
M.ARENARIA	*Mya arenaria*
M.PLANULATA	*Mysella planulata*
M.EDULIS	*Mytilus edulis*
N.OBSOLETUS	*Nassarius obsoletus*
N.TRIVITATUS	*Nassarius trivittatus*
N.VIBEX	*Nassarius vibex*
N.TEXANA	*Neopanope texana* and *Panopeus herbsti*
N.PROXIMA	*Nucula proxima*
NUDIBRANCH	Nudibranch
O.PRODUCTA	*Odostomia producta*
O.TRIFIDA	*Odostomia trifida*
OSTROCADA	Ostracoda

DREDGED SAMPLE VARIABLES - continued

Code	Name
O.OCELLATUS	*Ovalipes ocellatus*
P.BERNHARDUS	*Pagurus bernhardus*
P.LONGICARPUS	*Pagurus longicarpus*
P.GOULDIANA	*Pandora gouldiana*
P.PHOLADIFORMIS	*Petricola pholodiformis*
P.CHAETOPTERANA	*Pinnixa chaetopterana*
P.MORRHUANA	*Pitar morrhuana*
R.CANICULATA	*Retusa caniculata*
S.VELUM	*Solemya velum*
S.SOLIDISSIMA	*Spisula solidissima*
T.PLEBEUS	*Tagelus plebeius*
T.AGILUS	*Tellina agilis*
T.BRIAREUS	*Thyone briareus*
T.NIGROCINCTA	*Trifora nigrocincta*
T.INTERRUPTA	*Turbonilla interrupta*
U.CINEREA	*Urosalpinx cinerea*
Y.LIMATULA	*Yoldia limatula*

SPECIES	STATION							
	43C	43D	43E	44A	44B	44C	44D	45A
M.MANHATTENSIS	0	0	0	0	0	20	0	0
M.LATERALIS	15	5	1	3	9	27	0	1
M.ARENARIA	0	0	0	0	0	0	0	0
M.PLANULATA	0	0	0	0	0	0	0	0
M.EDULIS	0	0	0	0	5	0	0	0
N.OBSOLETUS	0	0	0	0	0	0	0	0
N.TRIVITATUS	0	0	0	0	0	0	0	0
N.VIBEX	0	0	0	0	0	0	0	0
N.TEXANA	3	0	3	4	3	1	6	3
N.PROXIMA	0	5	0	0	18	0	0	0
NUDIBRANCH	0	0	0	0	0	0	0	0
O.PRODUCTA	0	0	0	0	0	0	0	0
O.TRIFIDA	0	0	0	0	0	0	0	0
OSTRACODA	0	0	0	0	0	0	0	0
O.OCELLATUS	0	0	0	0	0	0	0	0
P.BERNHARDUS	0	0	0	0	0	0	0	0
P.LONGICARPUS	0	0	0	0	0	0	0	0
P.GOULDIANA	0	0	0	0	0	0	0	0
P.PHOLADIFORMIS	0	0	0	0	0	0	0	0
P.CHAETOPTERANA	0	0	0	0	0	0	0	0
P.MORRHAUNA	0	0	0	0	0	1	0	0
R.CANICULATA	12	0	0	0	16	1	0	0
S.VELUM	0	0	0	0	0	0	0	0
S.SOLIDISSIMA	0	0	0	0	0	0	0	0
T.PLEBEUS	0	0	0	0	0	0	0	0
T.AGILUS	4	9	8	0	1	7	4	1
T.BRIAREUS	0	0	1	0	0	1	0	0
T.NIGROCINTA	0	0	0	0	0	0	0	0
T.INTERRUPTA	0	0	0	0	0	0	0	0
U.CINEREA	0	0	0	0	0	0	1	0
Y.LIMATULA	0	0	0	0	0	0	0	0

DREDGED DATA SAMPLES

SPECIES	STATION 45C	45D	45E	45F	46A	46B	46C	46D	46E
A.PUNCTOSTRIATUS	0	0	0	0	0	0	0	0	0
A.IRRADIANS	0	0	0	0	0	0	0	0	0
A.ELEVATA	0	0	0	0	0	0	0	0	0
A.AVARA	0	0	0	0	0	0	0	0	0
A.TRANSVERSA	0	0	0	0	0	0	0	0	0
A.LENTUS	0	0	0	0	0	0	0	0	0
A.FORBESI	0	0	0	0	0	0	0	2	0
B.BALANOIDES	0	0	0	0	0	0	0	0	0
B.ALTERNATUM	0	0	0	0	0	0	0	0	0
B.CANALICULATUM	0	0	0	0	0	0	0	0	0
B.CARICA	0	0	0	0	0	0	0	0	0
C.IRRORATUS	0	0	0	0	0	0	0	0	0
C.CONVEXA	0	0	0	0	39	2	0	0	0
C.PLANA	0	0	0	0	0	1	0	1	4
E.DIRECTUS	0	0	0	0	0	1	0	0	0
E.RUPICOLA	0	0	0	0	0	0	0	0	0
E.CAUDATA	2	2	0	0	0	0	0	2	0
G.GEMMA	6	0	0	2	56	0	0	0	0
H.SOLITARIA	0	0	0	0	0	0	0	0	0
H.TOTTENI	0	0	0	0	0	0	0	0	0
L.DUBIA	0	0	0	0	0	0	0	0	0
L.VINCTA	0	0	0	0	0	0	0	0	0
L.MORTONI	0	0	0	0	0	0	0	0	0
L.POLYPHEMUS	0	0	0	0	0	0	0	0	0
L.LITTOREA	0	0	0	0	0	0	0	0	0
L.HYALINA	14	0	0	0	0	0	0	0	0
M.BALTHICA	0	0	0	0	0	0	0	0	0
M.TENTA	0	0	0	0	0	0	0	0	0
M.BIDENTATUS	0	0	0	0	0	0	0	0	0
M.MERCENARIA	13	2	1	1	16	17	1	1	0
M.LUNATA	0	0	0	0	0	0	0	0	0

SPECIES	STATION 45C	45D	45E	45F	46A	46B	46C	46D
M.MANHATTENSIS	0	0	0	0	0	0	0	0
M.LATERALIS	0	0	0	0	0	1	2	0
M.ARENARIA	0	0	0	0	0	0	0	0
M.PLANULATA	0	0	0	0	0	0	0	0
M.EDULIS	0	0	0	0	0	0	0	0
N.OBSOLETUS	0	0	0	0	0	0	0	0
N.TRIVITATUS	0	0	0	1	0	0	0	0
N.VIBEX	0	0	0	0	0	0	1	0
N.TEXANA	3	10	7	0	51	34	0	2
N.PROXIMA	10	0	0	0	0	57	15	0
NUDIBRANCH	0	0	0	0	0	0	0	0
O.PRODUCTA	0	0	0	0	0	0	0	0
O.TRIFIDA	0	0	0	0	0	0	0	0
OSTROCADA	15	0	0	0	0	0	0	0
O.OCELLATUS	0	0	0	0	0	0	0	0
P.BERNHARDUS	0	0	0	0	0	0	0	0
P.LONGICARPUS	0	0	0	0	0	0	0	0
P.GOULDIANA	0	0	0	0	0	1	0	0
P.PHOLADIFORMIS	0	0	0	0	0	0	0	0
P.CHAETOPTERANA	0	0	0	0	0	0	0	0
P.MORRHAUNA	0	0	0	0	0	0	0	0
R.CANICULATA	0	16	0	0	0	0	0	0
S.VELUM	0	0	0	0	0	0	0	0
S.SOLIDISSIMA	0	0	0	0	0	0	0	0
T.PLEBEUS	0	0	0	0	0	0	0	0
T.AGILUS	14	2	0	17	0	0	12	3
T.BRIAREUS	0	0	0	0	3	0	0	0
T.NIGROCINTA	0	0	0	0	0	0	0	0
T.INTERRUPTA	0	0	0	0	0	0	0	0
U.CINEREA	0	0	0	0	0	0	0	0
Y.LIMATULA	0	0	0	0	0	0	0	0

DREDGED DATA SAMPLES

SPECIES	46F	46G	47A	47B	47C	47D	47E	47F	48A
	STATION								
[illegible].PUNCTOSTRIATUS	0	0	0	0	2	0	0	0	0
A.IRRADIANS	0	0	0	0	0	0	0	0	0
A.ELEVATA	0	1	0	0	0	0	0	0	0
[illegible].AVARA	0	0	0	0	1	0	0	0	0
A.TRANSVERSA	0	0	0	0	0	0	0	0	0
A.LENTUS	0	0	0	0	0	0	0	0	0
[illegible].FOREESI	0	0	0	0	0	0	0	0	0
B.BALANOIDES	0	0	0	0	0	0	0	0	0
B.ALTERNATUM	0	0	0	0	3	0	0	0	0
[illegible].CANALICULATUM	0	0	0	0	0	0	0	0	0
[illegible].CARICA	0	0	0	0	0	0	0	0	0
C.IRRORATUS	0	0	0	0	0	0	0	0	0
[illegible].CONVEXA	0	0	0	0	0	0	0	0	6
[illegible].PLANA	2	1	0	0	0	0	0	0	0
E.DIRECTUS	0	0	20	0	3	0	0	0	0
E.RUPICOLA	0	0	0	0	0	0	0	0	0
E.CAUDATA	0	0	0	24	0	11	0	0	1
G.GEMMA	0	0	0	71	5	1	1	7	0
H.SOLITARIA	0	0	0	0	1	0	0	0	0
H.TOTTENI	0	0	0	0	0	0	0	0	0
L.DUBIA	0	0	0	0	0	0	0	0	0
L.VINCTA	0	0	0	0	0	0	0	0	0
L.MORTONI	0	0	0	0	1	0	0	0	0
L.POLYPHEMUS	0	0	0	0	0	0	0	0	0
L.LITTOREA	0	0	0	0	0	0	0	0	0
L.HYALINA	0	0	0	0	1	0	1	0	3
M.BALTHICA	0	0	6	0	0	0	0	0	0
M.TENTA	0	0	0	0	0	0	0	0	0
M.BIDENTATUS	0	0	0	0	0	0	0	0	0
M.MERCENARIA	3	0	8	3	6	2	6	0	3
M.LUNATA	0	0	0	0	2	0	0	0	0

SPECIES	46F	46G	47A	47B	47C	47D	47E	47F
M.MANHATTENSIS	0	0	0	0	0	0	0	7
M.LATERALIS	0	0	0	0	1	0	0	0
M.ARENARIA	0	0	102	0	0	0	0	0
M.PLANULATA	0	0	0	0	0	0	0	0
M.EDULIS	0	0	0	0	0	0	0	0
N.OBSOLETUS	0	0	1	0	0	0	0	0
N.TRIVITATUS	0	0	0	0	1	0	0	0
N.VIBEX	0	0	1	0	0	0	0	0
N.TEXANA	0	0	0	3	8	5	0	9
N.PROXIMA	0	0	3	0	9	0	1	0
NUDIBRANCH	0	0	0	0	0	0	0	0
O.PRODUCTA	0	0	0	0	0	0	0	0
O.TRIFIDA	0	0	0	0	0	0	0	0
OSTRACADA	0	0	0	0	0	0	0	0
O.OCELLATUS	0	0	0	0	0	0	0	0
P.BERNHARDUS	0	0	0	0	0	0	0	0
P.LONGICAPPUS	0	0	0	0	0	0	1	0
P.GOULDIANA	0	0	0	0	2	0	0	0
P.PHOLADIFORMIS	0	0	0	0	0	0	0	0
P.CHAETOPTERANA	1	0	0	0	0	0	0	0
P.MORRHAUNA	0	0	0	0	0	0	0	0
R.CANICULATA	0	0	0	0	11	0	0	0
S.VELUM	0	0	0	0	0	0	0	0
S.SOLIDISSIMA	0	0	0	0	0	0	0	0
T.PLEBEUS	0	0	0	0	0	0	0	0
T.AGILUS	8	5	0	0	2	1	3	0
T.BRIAREUS	0	0	0	0	0	0	0	0
T.NIGROCINTA	0	0	0	0	0	0	0	0
T.INTERRUPTA	0	0	0	0	0	0	0	0
U.CINEREA	0	0	0	0	0	0	0	0
Y.LIMATULA	0	0	0	0	0	0	0	0

DREDGED DATA SAMPLES

SPECIES	STATION							
	48B	48C	48D	48E	48F	49A	49B	49C	49
A.PUNCTOSTRIATUS	0	0	0	0	0	0	0	0	[illegible]
A.IRRADIANS	0	0	0	0	0	0	0	0	[illegible]
A.ELEVATA	0	0	0	0	0	0	0	0	[illegible]
A.AVARA	0	0	0	0	0	0	0	0	[illegible]
A.TRANSVERSA	0	0	0	0	0	0	0	0	[illegible]
A.LENTUS	0	0	0	0	0	0	0	0	[illegible]
A.FORBESI	0	0	0	0	0	0	0	0	[illegible]
B.BALANOIDES	0	0	0	0	0	0	0	0	0
B.ALTERNATUM	0	0	0	1	0	0	0	1	[illegible]
B.CANALICULATUM	0	0	0	0	0	0	0	0	0
B.CARICA	0	0	0	0	0	0	0	0	0
C.IRRORATUS	0	0	0	0	0	0	0	0	0
C.CONVEXA	0	0	0	4	0	0	1	0	0
C.PLANA	0	0	0	0	1	0	0	0	0
E.DIRECTUS	0	0	0	0	0	1	0	0	0
E.RUPICOLA	0	0	0	0	0	0	0	0	0
E.CAUDATA	4	5	1	1	0	0	4	4	0
G.GEMMA	163	23	51	0	15	0	21	6	19
H.SOLITARIA	0	0	0	0	0	0	0	0	0
H.TOTTENI	0	0	0	0	0	0	0	0	0
L.DUBIA	0	0	0	0	0	0	0	0	0
L.VINCTA	0	0	0	0	0	0	0	0	0
L.MORTONI	0	0	0	0	0	0	0	0	0
L.POLYPHEMUS	0	0	0	0	0	0	0	0	0
L.LITTOREA	0	0	0	0	0	0	0	0	0
L.HYALINA	1	1	3	2	0	0	4	0	4
M.BALTHICA	0	0	0	0	0	0	0	0	0
M.TENTA	0	0	0	0	0	0	0	0	0
M.BIDENTATUS	0	0	0	0	0	0	0	0	0
M.MERCENARIA	4	12	5	3	1	15	4	9	10
M.LUNATA	0	0	0	0	0	0	0	2	0

SPECIES	STATION 48B	48C	48D	48E	48F	49A	49B	49C	49
M.MANHATTENSIS	0	0	0	0	0	0	0	0	
M.LATERALIS	0	0	0	1	0	0	0	0	
M.ARENARIA	0	0	0	0	0	15	0	0	
M.PLANULATA	0	0	0	0	0	0	0	0	
M.EDULIS	0	0	0	0	0	0	0	0	
N.OBSOLETUS	0	0	0	0	0	0	0	0	
N.TRIVITATUS	0	0	0	0	0	0	0	0	
N.VIBEX	0	0	0	0	0	0	0	0	
N.TEXANA	2	3	1	1	0	9	0	2	
N.PROXIMA	5	0	1	0	0	3	6	1	
NUDIBRANCH	0	0	0	0	0	0	0	0	
O.PRODUCTA	0	0	0	0	0	0	0	0	
O.TRIFIDA	0	0	0	0	0	0	0	0	
OSTROCADA	0	0	0	0	0	0	0	0	
O.OCELLATUS	0	0	0	0	0	0	0	0	
P.BERNHARDUS	0	0	0	0	0	0	0	0	
P.LONGICARPUS	0	0	0	0	0	0	0	0	
P.GOULDIANA	0	0	0	0	0	0	0	0	
P.PHOLADIFORMIS	0	0	0	0	0	0	0	0	
P.CHAETOPTERANA	0	0	0	0	0	0	0	0	
P.MORRHAUNA	0	0	0	0	0	0	0	0	
R.CANICULATA	0	0	0	0	0	0	0	0	
S.VELUM	0	1	1	0	0	4	1	0	
S.SOLIDISSIMA	0	0	0	0	0	0	0	0	
T.PLEBEUS	0	0	0	0	0	0	0	0	
T.AGILUS	0	1	4	2	0	0	1	3	
T.BRIAREUS	0	0	0	0	0	0	1	0	
T.NIGROCINTA	0	0	0	0	0	0	0	0	
T.INTERRUPTA	0	0	0	0	0	0	0	0	
U.CINEREA	0	3	0	0	0	0	0	1	
Y.LIMATULA	0	0	0	0	0	0	0	0	

DREDGED DATA SAMPLES

SPECIES	STATION 49E	50A	50B	50C	50D	50E	51A	51B	51C
A.PUNCTOSTRIATUS	0	0	0	0	0	0	1	1	0
A.IRRADIANS	0	0	0	0	0	0	0	0	0
A.ELEVATA	0	0	0	0	0	0	0	0	0
A.AVARA	0	0	0	0	0	0	0	0	0
A.TRANSVERSA	0	0	0	0	0	0	0	0	0
A.LENTUS	0	0	0	0	0	0	0	0	0
A.FORBESI	0	0	0	0	0	0	0	0	0
B.BALANOIDES	0	0	0	1	0	0	0	0	0
B.ALTERNATUM	0	0	0	14	0	0	0	5	0
B.CANALICULATUM	0	0	0	0	0	0	0	0	0
B.CARICA	0	0	0	0	0	0	0	0	0
C.IRRORATUS	0	0	0	0	0	0	0	0	0
C.CONVEXA	0	8	1	4	0	3	1	1	0
C.PLANA	0	0	0	0	0	0	0	0	0
E.DIRECTUS	0	2	0	1	0	0	0	1	1
E.RUPICOLA	0	0	0	0	0	0	0	0	0
E.CAUDATA	0	0	0	9	0	2	0	5	3
G.GEMMA	0	3	11	20	32	20	53	73	92
H.SOLITARIA	0	0	0	0	11	0	2	0	0
H.TOTTENI	0	0	0	0	0	0	0	0	0
L.DUBIA	0	0	0	0	0	0	0	0	0
L.VINCTA	0	0	0	0	0	0	0	0	0
L.MORTONI	0	0	0	0	0	0	0	0	0
L.POLYPHEMUS	0	0	0	0	0	0	0	0	0
L.LITTOREA	0	0	0	0	0	0	0	0	0
L.HYALINA	0	1	1	0	1	2	0	1	1
M.BALTHICA	0	0	0	0	0	0	7	0	0
M.TENTA	0	0	0	0	0	0	0	0	0
M.BIDENTATUS	0	0	0	0	0	0	0	0	0
M.MERCENARIA	1	0	3	5	2	5	4	3	0
M.LUNATA	0	0	1	0	0	0	0	3	0

SPECIES	STATION								
	49E	50A	50B	50C	50D	50E	51A	51B	51
M.MANHATTENSIS	0	0	0	0	0	0	0	0	
M.LATERALIS	0	0	0	0	0	0	0	12	
M.ARENARIA	0	0	0	0	0	0	1367	0	
M.PLANULATA	0	0	0	0	0	0	0	0	
M.EDULIS	0	0	0	0	0	0	1	0	
N.OBSOLETUS	0	0	0	0	0	0	0	0	
N.TRIVITATUS	0	0	0	0	0	0	0	0	
N.VIBEX	0	0	0	0	0	0	0	0	
N.TEXANA	0	51	3	4	2	1	1	1	
N.PROXIMA	0	1	0	0	0	0	0	2	
NUDIBRANCH	0	0	0	0	0	0	0	0	
O.PRODUCTA	0	0	0	0	0	0	0	0	
O.TRIFIDA	0	0	0	0	0	0	0	0	
OSTROCADA	0	0	0	0	0	0	0	0	
O.OCELLATUS	0	0	0	0	0	0	0	0	
P.BERNHARDUS	0	0	0	0	0	0	0	0	
P.LONGICARPUS	0	0	0	0	0	0	0	0	
P.GOULDIANA	0	0	0	0	0	0	0	0	
P.PHOLADIFORMIS	0	0	0	0	0	0	1	0	
P.CHAETCPTERANA	0	0	0	0	0	0	0	0	
P.MORPHAUNA	0	0	0	0	0	0	0	0	
R.CANICULATA	0	0	0	0	0	0	0	0	
S.VELUM	0	0	0	1	0	0	0	0	
S.SOLIDISSIMA	0	0	0	0	0	0	0	0	
T.PLEBEUS	0	0	0	0	0	0	0	0	
T.AGILUS	2	0	2	2	1	0	0	13	
T.BRIAREUS	0	0	0	0	0	0	0	0	
T.NIGROCINTA	0	0	0	0	0	0	0	0	
T.INTERRUPTA	0	0	0	0	0	0	0	0	
U.CINEREA	0	1	0	0	0	0	1	0	
Y.LIMATULA	0	0	0	0	0	0	0	0	

DREDGED DATA SAMPLES

SPECIES	STATION								
	51D	52A	52B	52C	52D	53A	53B	53C	54A
A.PUNCTOSTRIATUS	0	0	0	0	0	0	0	0	0
A.IRRADIANS	0	0	0	0	0	0	0	0	0
A.ELEVATA	0	0	0	0	0	0	0	0	0
A.AVARA	0	0	0	0	0	0	0	0	0
A.TRANSVERSA	0	0	0	0	0	0	0	0	0
A.LENTUS	0	0	0	0	0	0	0	0	0
A.FORBESI	0	0	0	0	0	0	0	0	0
B.BALANOIDES	0	0	0	0	0	0	0	0	0
B.ALTERNATUM	0	0	0	0	0	0	6	0	0
B.CANALICULATUM	0	0	0	0	0	0	0	0	0
B.CARICA	0	0	0	0	0	0	0	0	0
C.IRRORATUS	0	0	0	0	0	0	0	0	0
C.CONVEXA	0	99	3	1	0	2	6	1	2
C.PLANA	0	0	0	0	0	0	0	0	0
E.DIRECTUS	0	0	0	0	0	0	0	0	1
E.RUPICOLA	0	0	0	0	0	0	0	0	0
E.CAUDATA	0	0	0	0	1	0	3	0	0
G.GEMMA	2239	7	0	0	181	0	294	86	183
H.SOLITARIA	0	0	0	0	8	0	0	0	0
H.TOTTENI	0	0	0	0	0	0	0	0	0
L.DUEIA	0	1	0	0	0	0	0	0	0
L.VINCTA	0	0	0	0	1	0	0	0	0
L.MORTONI	0	0	0	0	0	0	0	0	0
L.POLYPHEMUS	0	3	0	0	0	0	0	0	0
L.LITTOREA	0	0	0	0	0	0	0	0	0
L.HYALINA	0	1	1	0	0	0	2	1	9
M.BALTHICA	0	0	0	0	21	0	0	0	0
M.TENTA	0	0	0	0	0	0	0	0	0
M.BIDENTATUS	0	0	0	0	0	0	0	0	0
M.MERCENARIA	0	10	0	2	0	0	3	1	0
M.LUNATA	0	0	0	0	0	0	0	0	0

SPECIES	STATION								
	51D	52A	52B	52C	52D	53A	53B	53C	54
M.MANHATTENSIS	0	0	0	0	0	0	0	0	
M.LATERALIS	0	0	0	0	0	0	0	0	
M.ARENARIA	70	0	0	0	19	0	0	0	
M.PLANULATA	0	0	0	0	0	0	0	0	
M.EDULIS	0	0	0	1	0	0	0	0	
N.OBSOLETUS	0	0	0	0	1	0	0	0	
N.TRIVITATUS	0	0	0	0	0	0	0	0	
N.VIBEX	0	0	0	0	0	0	0	0	
N.TEXANA	0	11	2	6	0	2	0	3	
N.PROXIMA	0	0	0	0	0	0	1	0	
NUDIBRANCH	1	0	0	0	0	0	0	0	
O.PRODUCTA	0	0	0	0	0	0	0	0	
O.TRIFIDA	0	0	0	0	0	0	0	0	
OSTRACODA	15	0	0	0	0	0	0	0	
O.OCELLATUS	0	0	0	0	0	0	0	0	
P.BERNHARDUS	0	0	0	0	0	0	0	0	
P.LONGICARPUS	0	0	0	0	0	0	0	0	
P.GOULDIANA	0	0	0	0	0	0	0	0	
P.PHOLADIFORMIS	0	0	0	0	0	0	0	0	
P.CHAETOPTERANA	0	0	0	0	0	0	0	0	
P.MORRHAUNA	0	0	0	0	0	0	0	0	
R.CANICULATA	0	0	0	0	0	0	0	0	
S.VELUM	0	0	0	0	0	0	0	0	
S.SOLIDISSIMA	0	0	0	0	0	0	0	0	
T.PLEBEUS	0	0	0	0	0	0	0	0	
T.AGILUS	0	0	2	1	0	0	6	5	
T.BRIAREUS	0	1	1	0	1	0	0	0	
T.NIGROCINTA	0	0	0	0	0	0	0	0	
T.INTERRUPTA	0	0	0	0	0	0	0	0	
U.CINEREA	0	1	0	0	0	0	1	0	
Y.LIMATULA	0	0	0	0	0	0	0	0	

DREDGED DATA SAMPLES

SPECIES	54B	54C	54D	55A	55B	55C	55D	56A	56B
A.PUNCTOSTRIATUS	0	0	0	0	0	0	0	0	0
A.IRRADIANS	0	0	0	0	0	0	0	0	0
A.ELEVATA	0	0	0	0	0	0	0	0	0
A.AVARA	0	0	0	0	0	0	0	0	0
A.TRANSVERSA	0	0	0	0	0	0	0	0	0
A.LENTUS	0	0	0	0	0	0	0	0	0
A.FORBESI	0	0	0	0	0	0	0	0	0
B.BALANOIDES	0	0	0	0	0	0	0	0	0
B.ALTERNATUM	0	0	0	0	0	0	0	0	0
B.CANALICULATUM	0	0	0	0	0	0	0	0	0
B.CARICA	0	0	0	0	0	0	0	0	0
C.IRRORATUS	0	0	0	0	0	0	0	0	0
C.CONVEXA	2	0	0	35	0	0	1	7	0
C.PLANA	0	0	0	0	0	0	0	0	0
E.DIRECTUS	0	1	0	0	0	0	0	0	1
E.RUPICOLA	0	0	0	0	0	0	0	0	0
E.CAUDATA	0	0	0	1	0	0	0	0	0
G.GEMMA	0	15	771	19	4	159	108	20	12
H.SOLITARIA	0	0	0	0	0	0	0	3	0
H.TOTTENI	0	0	0	0	0	0	0	0	0
L.DUBIA	0	0	0	0	0	0	0	0	0
L.VINCTA	0	0	0	0	0	0	0	0	0
L.MORTONI	0	0	0	0	0	0	0	0	0
L.POLYPHEMUS	0	0	0	0	0	0	0	0	0
L.LITTOREA	0	0	0	0	0	0	0	0	0
L.HYALINA	0	0	1	5	0	0	2	8	1
M.BALTHICA	0	0	0	0	0	0	0	0	0
M.TENTA	0	0	0	0	0	0	0	0	0
M.BIDENTATUS	0	0	0	0	0	0	0	0	0
M.MERCENARIA	1	1	0	3	5	1	1	0	2
M.LUNATA	0	0	0	0	0	0	0	0	0

SPECIES	54B	54C	54D ✓	55A	55B	55C	55D ✓	56A	56
M.MANHATTENSIS	0	0	0	0	0	0	0	0	0
M.LATERALIS	0	0	0	0	0	0	0	0	[illegible]
M.ARENARIA	0	0	0	0	0	0	0	0	[illegible]
M.PLANULATA	0	0	0	0	0	0	0	0	0
M.EDULIS	0	0	0	0	0	0	0	0	[illegible]
N.OBSOLETUS	0	0	0	0	0	0	0	0	[illegible]
N.TRIVITATUS	0	0	0	0	0	0	0	0	[illegible]
N.VIBEX	0	0	0	0	0	0	0	0	0
N.TEXANA	1	0	0	1	0	0	0	0	[illegible]
N.PROXIMA	0	0	0	0	0	0	0	0	[illegible]
NUDIBRANCH	0	0	0	0	0	0	0	0	0
O.PRODUCTA	0	0	0	0	0	0	0	0	[illegible]
O.TRIFIDA	0	0	0	0	0	0	0	0	[illegible]
OSTROCADA	0	0	0	0	0	0	0	0	0
O.OCELLATUS	0	0	0	0	0	0	1	0	[illegible]
P.BERNHARDUS	0	0	0	0	0	0	0	0	[illegible]
P.LONGICARPUS	0	0	0	0	0	0	0	0	0
P.GOULDIANA	0	0	0	0	0	0	0	0	[illegible]
P.PHOLADIFORMIS	0	0	0	0	0	0	0	0	[illegible]
P.CHAETOPTERANA	0	0	0	0	0	0	0	0	0
P.MORRHAUNA	0	0	0	0	0	0	0	0	0
R.CANICULATA	0	0	0	0	0	0	0	0	[illegible]
S.VELUM	0	0	0	0	1	2	6	0	[illegible]
S.SOLIDISSIMA	0	0	0	0	0	0	0	0	0
T.PLEBEUS	0	0	0	0	0	0	0	0	[illegible]
T.AGILUS	1	0	0	1	0	1	1	1	[illegible]
T.BRIAREUS	0	0	0	0	0	0	0	0	0
T.NIGROCINTA	0	0	0	0	0	0	0	0	[illegible]
T.INTERRUPTA	0	0	0	0	0	0	0	0	[illegible]
U.CINEREA	0	0	0	0	0	0	1	1	0
Y.LIMATULA	0	0	0	0	0	0	0	0	[illegible]

DREDGED DATA SAMPLES

SPECIES	STATION 56C	56D	56E	57A	57B	57C	57D	58A	58B
A.PUNCTOSTRIATUS	0	0	0	0	0	0	0	0	0
A.IRRADIANS	0	0	0	0	0	0	0	0	0
A.ELEVATA	0	0	0	0	0	0	0	0	0
A.AVARA	0	0	0	0	0	0	0	0	0
A.TRANSVERSA	0	0	0	0	0	0	0	0	0
A.LENTUS	0	0	0	0	0	0	0	0	0
A.FORBESI	0	0	0	0	0	0	0	0	0
B.BALANOIDES	0	0	0	0	0	0	0	0	0
B.ALTERNATUM	0	0	0	0	0	0	0	0	1
B.CANALICULATUM	0	0	0	0	0	0	0	0	0
B.CARICA	0	0	0	0	0	0	0	0	0
C.IRRORATUS	0	0	0	0	0	0	0	0	0
C.CONVEXA	[illegible]	1	2	4	0	0	0	0	0
C.PLANA	0	0	0	0	0	0	0	0	0
E.DIRECTUS	0	0	0	0	0	0	0	0	0
E.RUPICOLA	0	0	0	0	0	0	0	0	0
E.CAUDATA	0	0	1	0	0	0	0	0	0
G.GEMMA	0	6	1	1	4	21	1464	77	4
H.SOLITARIA	0	0	0	0	0	0	0	0	0
H.TOTTENI	0	0	0	0	0	0	0	0	0
L.DUBIA	0	0	0	0	0	0	0	0	0
L.VINCTA	0	0	0	0	0	0	0	0	0
L.MORTONI	0	0	0	0	0	0	0	0	0
L.POLYPHEMUS	0	0	0	0	1	0	0	0	0
L.LITTOREA	0	0	0	0	0	0	0	0	0
L.HYALINA	[illegible]	2	9	19	6	3	1	1	3
M.BALTHICA	0	0	0	0	0	0	0	0	0
M.TENTA	0	0	0	0	0	0	0	0	0
M.BIDENTATUS	0	0	0	0	0	0	0	0	0
M.MERCENARIA	0	0	1	2	3	1	3	0	4
M.LUNATA	0	0	0	0	0	0	0	0	0

SPECIES	STATION							
	56C	56D	56E	57A	57B	57C	57D	58A
M.MANHATTENSIS	0	0	0	0	0	0	0	0
M.LATERALIS	0	0	0	0	0	0	0	0
M.ARENARIA	0	0	0	0	0	0	0	0
M.PLANULATA	0	0	0	0	0	0	0	0
M.EDULIS	0	0	0	0	3	0	0	0
N.OBSOLETUS	0	0	0	0	0	0	0	0
N.TRIVITTATUS	0	0	0	0	0	0	0	0
N.VIBEX	0	0	0	0	0	0	0	0
N.TEXANA	0	0	0	0	0	0	0	1
N.PROXIMA	0	0	0	1	0	0	0	0
NUDIBRANCH	0	0	0	0	0	0	0	0
O.PRODUCTA	0	0	0	0	0	0	0	0
O.TRIFIDA	0	0	0	0	0	0	0	0
OSTROCADA	0	0	0	0	0	0	0	0
O.OCELLATUS	0	0	0	0	0	0	0	0
P.BERNHARDUS	0	0	0	0	0	0	0	0
P.LONGICARPUS	0	0	0	0	0	0	0	0
P.GOULDIANA	0	0	0	0	0	0	0	0
P.PHOLADIFORMIS	0	0	0	0	0	0	0	0
P.CHAETOPTERANA	0	0	0	0	0	0	0	0
P.MORRHAUNA	0	0	0	0	0	0	0	0
R.CANICULATA	0	0	0	0	0	0	0	0
S.VELUM	3	11	83	1	25	23	10	0
S.SOLIDISSIMA	0	0	0	0	0	0	0	0
T.PLEBEUS	0	0	0	0	0	0	0	0
T.AGILUS	0	0	0	0	1	0	1	1
T.BRIAREUS	1	0	0	0	0	0	0	0
T.NIGROCINTA	0	0	0	0	0	0	0	0
T.INTERRUPTA	0	0	0	0	0	0	0	0
U.CINEREA	0	0	1	0	0	0	0	0
Y.LIMATULA	0	0	0	0	0	0	0	0

DREDGED DATA SAMPLES

SPECIES	STATION								
	58C	58D	58E	58F	59A	59B	59C	59D	60A
A.PUNCTOSTRIATUS	0	0	0	0	0	0	0	0	0
A.IRRADIANS	0	0	0	0	0	0	0	0	0
A.ELEVATA	0	0	0	0	0	0	0	0	0
A.AVARA	0	0	0	0	0	0	0	0	0
A.TRANSVERSA	0	0	0	0	0	0	0	0	0
A.LENTUS	0	0	0	0	0	0	0	0	0
A.FORBESI	0	0	0	0	0	0	0	0	0
B.BALANOIDES	0	0	0	0	0	0	0	0	0
B.ALTERNATUM	0	0	0	2	0	0	0	0	0
B.CANALICULATUM	0	0	0	0	0	0	0	1	0
B.CARICA	0	0	0	0	0	0	0	0	0
C.IRRORATUS	0	0	0	0	0	0	0	0	0
C.CONVEXA	1	0	0	31	0	0	1	1	0
C.PLANA	0	0	0	0	1	0	0	0	0
E.DIRECTUS	0	0	0	1	0	1	0	0	0
E.RUPICOLA	0	0	0	0	0	0	0	0	0
E.CAUDATA	0	0	166	0	0	0	1	0	0
G.GEMMA	47	1691	0	0	0	0	10	0	0
H.SOLITARIA	0	0	0	0	0	0	0	0	0
H.TOTTENI	0	0	0	0	0	0	0	0	0
L.DUBIA	0	0	0	0	0	0	0	0	0
L.VINCTA	0	0	0	0	0	0	0	1	0
L.MORTONI	0	0	0	0	0	0	0	0	0
L.POLYPHEMUS	0	1	0	0	0	0	0	0	0
L.LITTOREA	0	0	0	0	0	0	0	0	0
L.HYALINA	10	0	0	7	2	0	2	1	0
M.BALTHICA	0	0	0	1	0	0	0	0	7
M.TENTA	0	0	0	0	0	0	0	0	1
M.BIDENTATUS	0	0	0	0	0	0	0	0	0
M.MERCENARIA	0	0	0	5	5	2	1	4	0
M.LUNATA	0	0	0	0	0	0	0	0	0

SPECIES	58C	58D	58E	58F	59A	59B	59C	59D	6C
				STATION					
M.MANHATTENSIS	0	0	0	24	0	2	0	0	
M.LATERALIS	0	0	0	0	0	0	0	0	
M.ARENARIA	0	0	0	0	0	0	0	0	
M.PLANULATA	0	0	0	0	0	0	0	1	
M.EDULIS	0	0	0	0	0	0	0	0	
N.OBSOLETUS	0	0	0	2	0	0	0	0	1
N.TRIVITATUS	0	0	0	0	0	0	0	0	
N.VIBEX	0	0	0	0	0	0	0	0	
N.TEXANA	0	0	0	0	0	1	0	1	
N.PROXIMA	0	0	0	0	0	0	0	0	
NUDIBRANCH	0	0	0	0	0	0	0	0	
O.PRODUCTA	0	0	0	0	0	0	0	0	
O.TRIFIDA	0	0	0	0	0	0	0	0	
OSTROCADA	0	0	0	0	0	0	0	5	
O.OCELLATUS	0	0	0	0	0	0	1	0	
P.BERNHARDUS	0	0	0	0	0	0	0	0	
P.LONGICARPUS	1	0	0	0	0	0	0	0	
P.GOULDIANA	0	0	0	0	0	0	0	0	
P.PHOLADIFORMIS	0	0	0	0	0	0	0	0	
P.CHAETOPTERANA	0	0	0	0	0	0	0	0	
P.MORRHAUNA	0	0	0	0	0	0	0	0	
R.CANICULATA	0	0	0	0	0	0	0	0	
S.VELUM	7	4	6	1	0	11	4	3	
S.SOLIDISSIMA	0	0	0	0	0	0	0	0	
T.PLEBEUS	0	0	0	0	0	0	0	0	
T.AGILUS	2	0	47	9	0	1	0	23	
T.BRIAREUS	1	0	0	0	0	0	0	0	
T.NIGROCINTA	0	0	0	0	0	0	0	0	
T.INTERRUPTA	0	0	0	0	0	0	0	0	
U.CINEREA	0	0	1	2	0	0	0	0	
Y.LIMATULA	0	0	0	0	0	0	0	0	

DREDGED DATA SAMPLES

SPECIES	STATION 60B	60C	60D	60E	60F	60G	61A	61B	61C
A.PUNCTOSTRIATUS	0	0	0	0	0	0	0	0	0
A.IRRADIANS	0	0	0	0	0	0	0	0	0
A.ELEVATA	0	0	0	0	0	0	0	0	0
A.AVARA	0	0	0	0	0	0	0	0	0
A.TRANSVERSA	0	0	0	0	0	0	0	0	0
A.LENTUS	4	0	0	0	0	0	0	0	0
A.FORBESI	0	0	0	0	0	0	0	0	0
B.BALANOIDES	0	0	0	0	0	0	0	0	0
B.ALTERNATUM	0	0	0	0	0	0	0	1	0
B.CANALICULATUM	0	0	0	0	0	0	0	0	0
B.CARICA	0	0	0	0	0	0	0	0	0
C.IRRORATUS	0	0	0	0	0	0	0	0	0
C.CONVEXA	3	0	1	0	0	0	1	0	0
C.PLANA	0	0	0	0	0	0	0	0	0
E.DIRECTUS	0	0	0	0	1	0	0	0	0
E.RUPICOLA	0	0	0	0	0	0	0	0	0
E.CAUDATA	2	0	1	0	7	0	0	0	0
G.GEMMA	13	0	3767	122	1089	0	20	0	266
H.SOLITARIA	0	0	0	0	0	0	0	0	0
H.TOTTENI	0	0	0	0	1	0	0	0	0
L.DUBIA	0	0	0	0	0	0	0	0	0
L.VINCTA	0	0	0	0	0	0	0	0	0
L.MORTONI	0	0	0	0	0	0	0	0	0
L.POLYPHEMUS	0	0	0	0	0	0	0	0	0
L.LITTOREA	0	0	0	0	0	0	0	0	0
L.HYALINA	0	3	4	7	5	1	18	0	2
M.BALTHICA	0	0	0	0	0	0	0	0	0
M.TENTA	0	0	0	0	0	0	0	0	0
M.BIDENTATUS	0	0	0	0	1	0	0	0	0
M.MERCENARIA	0	2	0	0	0	1	1	0	0
M.LUNATA	0	0	0	0	0	0	0	0	0

SPECIES	60B	60C	60D	60E	60F	60G	61A	61B	61[illegible]
M.MANHATTENSIS	0	0	0	0	0	0	0	0	[illegible]
M.LATERALIS	0	1	0	0	0	0	0	0	[illegible]
M.ARENARIA	0	0	0	0	0	0	0	0	0
M.PLANULATA	0	0	0	0	0	0	0	0	[illegible]
M.EDULIS	0	0	0	0	0	0	0	0	[illegible]
N.OBSOLETUS	0	0	0	0	0	0	0	0	[illegible]
N.TRIVITATUS	0	0	0	0	0	0	0	0	[illegible]
N.VIBEX	0	0	0	0	0	0	0	0	[illegible]
N.TEXANA	0	0	0	0	0	0	0	0	[illegible]
N.PROXIMA	0	0	0	0	0	0	0	0	[illegible]
NUDIBRANCH	0	0	0	0	0	0	0	0	[illegible]
O.PRODUCTA	0	0	0	0	0	0	0	0	[illegible]
O.TRIFIDA	0	0	0	0	0	0	0	0	[illegible]
OSTROCADA	0	0	0	0	0	0	0	0	[illegible]
O.OCELLATUS	1	0	0	0	0	0	0	0	[illegible]
P.BERNHARDUS	0	0	0	0	0	0	0	0	[illegible]
P.LONGICARPUS	0	0	0	0	0	0	0	0	[illegible]
P.GOULDIANA	0	0	0	0	0	0	0	0	[illegible]
P.PHOLADIFORMIS	0	0	0	0	0	0	0	0	[illegible]
P.CHAETOPTERANA	0	0	0	0	0	0	0	0	[illegible]
P.MORRHAUNA	0	0	0	0	0	0	0	0	[illegible]
R.CANICULATA	0	0	0	0	0	0	0	0	[illegible]
S.VELUM	0	6	19	9	14	0	3	0	1
S.SOLIDISSIMA	0	0	0	0	0	0	0	0	[illegible]
T.PLEBEUS	0	0	0	0	0	0	0	0	[illegible]
T.AGILUS	3	5	4	1	2	15	6	6	1
T.BRIAREUS	0	0	0	1	0	0	0	0	[illegible]
T.NIGROCINTA	0	0	0	0	0	0	0	0	[illegible]
T.INTERRUPTA	0	0	0	0	0	0	0	0	[illegible]
U.CINEREA	1	0	0	0	0	0	0	1	[illegible]
Y.LIMATULA	0	0	0	0	0	0	0	0	[illegible]

TONGED SAMPLE VARIABLES

Code	Name
A.IRRADIANS	Aequipecten irradians
O.OVALIS	Anadara ovalis
A.TRANSVERSA	Anadara transversa
A.SIMPLEX	Anomia simplex
A.FORBESI	Asterias forbesi
B.ALTERNATUM	Bittium alternatum
B.CANALICULATUM	Busycon canaliculatum
B.CARICA	Busycon carica
C.SAPIDUS	Calinectes sapidus
C.IRRORATUS	Cancer irroratus
C.VIRGINICA	Crassostrea virginica
C.CONVEXA	Crepidula convexa and C. fornicata
C.PLANA	Crepidula plana
E.DIRECTUS	Ensis directus
E.CAUDATA	Eupleura caudata
H.SOLITARIA	Haminola solitaria
L.MORTONI	Laevicardium mortoni
L.DUBIA	Labina dubia
L.POLYPHEMUS	Limulus polyphemus
L.LITTOREA	Littorina littorea
L.HEROS	Lunatia heros
L.HYALINA	Lyonsia hyalina
M.BALTHICA	Macoma balthica
M.TENTA	Macoma tenta
M.DEMISSUS	Modiolus demissus
M.MANHATTENSIS	Molgula manhattensis
M.LATERALIS	Mulinia lateralis
M.ARENARIA	Mya arenaria
M.EDULIS	Mytilus edulis
N.OBSOLETUS	Nassarius obsoletus
N.TRIVITATUS	Nassarius trivitatus
N.VIBEX	Nassarius vibex
N.TEXANA	Neopanope texana sayi and Paneopeus herbsti
N.PROXIMA	Nucula proxima
O.OCELLATUS	Ovalipes ocellatus
P.LONGICARPUS	Pagurus longicarpus
P.GOULDIANA	Pandora gouldiana
P.PHOLADIFORMIS	Petricola pholadiformis
P.MORRHUANA	Pitar morrhuana
P.DUPLICATUS	Polinices duplicatus
S.VELUM	Solemya velum
S.SOLIDISSIMA	Spisula solidissima
T.PLEBEIUS	Tagelus plebeius
T.AGILUS	Tellina agilus
T.BRIAREUS	Thyone briareus
U.CINEREA	Urosalpinx cinerea
Y.LIMATULA	Yoldia limatula

TONGED DATA SAMPLES

SPECIES	STATION 43C	43D	43E	44A	44B	44C	44D	45A	45B
A.IRRADIANS	0	0	0	0	0	0	0	0	0
A.OVALIS	0	0	0	0	0	0	0	0	[illegible]
A.TRANSVERSA	0	0	0	0	0	0	0	0	[illegible]
A.SIMPLEX	0	0	0	0	0	0	0	0	0
A.FORBESI	0	0	0	0	0	0	0	0	[illegible]
B.ALTERNATUM	0	0	0	0	0	0	0	0	[illegible]
B.CANALICULATUM	1	0	0	0	6	3	0	1	2
B.CARICA	0	0	0	0	0	0	0	0	[illegible]
C.SAPIDUS	0	0	0	0	0	0	0	0	[illegible]
C.IRRORATUS	0	0	0	0	0	0	0	0	0
C.VIRGINICA	0	0	0	0	0	0	0	0	[illegible]
C.CONVEXA	462	0	0	24	15	5	0	0	1[illegible]
C.PLANA	0	0	0	0	0	0	0	0	0
E.DIRECTUS	0	1	0	40	3	0	0	2	[illegible]
E.CAUDATA	1	0	26	12	0	0	5	0	[illegible]
H.SOLITARIA	0	0	0	0	0	0	0	0	[illegible]
L.MORTONI	0	0	0	0	0	0	0	0	[illegible]
L.DUBIA	2	1	0	0	0	0	0	0	[illegible]
L.POLYPHEMUS	0	0	0	0	1	0	0	0	[illegible]
L.LITTOREA	0	0	0	0	0	0	0	0	0
L.HEROS	0	0	0	0	0	0	0	0	[illegible]
L.HYALINA	0	0	0	0	0	0	0	0	[illegible]
M.BALTHICA	0	0	0	0	0	0	0	0	0
M.TENTA	0	0	0	0	0	0	0	0	[illegible]
M.MERCENARIA	162	121	16	76	130	126	104	32	11[illegible]
M.DEMISSUS	0	0	0	0	0	0	0	0	0
M.MANHATTENSIS	0	0	0	0	0	0	0	0	0
M.LATERALIS	0	0	0	0	0	0	0	0	[illegible]
M.ARENARIA	0	0	0	0	0	0	0	0	[illegible]
M.EDULIS	0	0	0	0	72	0	0	0	4
N.OBSOLETUS	0	0	0	0	0	0	0	0	[illegible]
N.TRIVITTATUS	0	0	0	0	0	0	0	0	[illegible]
N.VIBEX	0	0	0	0	0	0	0	0	0
N.TEXANA	19	2	1	5	21	9	13	12	1[illegible]
N.PROXIMA	0	0	0	0	3	0	0	0	[illegible]
O.OCELLATUS	0	0	4	0	0	0	0	0	0
P.LONGICARPUS	1	0	4	0	0	0	0	0	[illegible]
P.GOULDIANA	0	0	0	0	0	0	0	0	[illegible]
P.PHOLADIFORMIS	0	0	0	0	0	0	0	0	0
P.MORRHUANA	0	0	0	0	0	0	0	0	0
P.DUPLICATUS	0	0	0	0	0	0	0	0	[illegible]
S.VELUM	0	0	0	0	0	0	0	0	[illegible]
S.SOLIDISSIMA	0	0	0	0	1	0	0	0	0
T.PLEBEIUS	0	0	0	0	0	0	0	0	[illegible]
T.AGILIS	0	0	0	0	0	0	0	0	[illegible]
T.BRIAREUS	0	0	0	0	0	0	0	0	0
U.CINEREA	0	0	1	1	1	0	6	0	[illegible]
Y.LIMATULA	0	0	0	0	0	0	0	0	[illegible]

TONGED DATA SAMPLES

SPECIES	STATION 45C	45D	45E	45F	46A	46B	46C	46D	46E
A.IRRADIANS	0	0	0	0	0	0	0	0	0
A.OVALIS	0	0	0	0	0	0	0	0	0
A.TRANSVERSA	0	0	0	0	0	0	0	0	0
A.SIMPLEX	0	0	0	0	0	0	0	0	0
A.FORBESI	1	1	0	0	0	0	0	0	0
B.ALTERNATUM	0	0	0	0	0	0	0	0	0
B.CANALICULATUM	0	1	0	0	0	3	0	1	0
B.CARICA	0	0	0	0	0	0	0	0	0
C.SAPIDUS	0	0	0	0	0	0	0	0	0
C.IRRORATUS	0	0	0	0	0	0	0	0	0
C.VIRGINICA	0	0	0	0	0	0	0	0	0
C.CONVEXA	0	0	0	0	0	0	0	0	0
C.PLANA	0	0	0	0	0	0	0	0	0
E.DIRECTUS	0	0	0	0	26	7	2	0	0
E.CAUDATA	0	19	0	1	2	1	0	0	0
H.SOLITARIA	0	0	0	0	0	0	0	0	0
L.MORTONI	0	0	0	0	0	0	0	0	0
L.DUBIA	0	0	1	7	0	0	0	0	0
L.POLYPHEMUS	0	0	0	0	0	0	0	0	0
L.LITTOREA	0	0	0	0	0	0	0	0	0
L.HEROS	0	0	0	0	0	0	0	0	0
L.HYALINA	0	0	0	0	0	0	0	0	0
M.BALTHICA	0	0	0	0	0	0	0	0	0
M.TENTA	0	0	0	0	0	0	0	0	0
M.MERCENARIA	93	87	64	24	299	293	48	61	19
M.DEMISSUS	0	0	0	0	0	0	0	0	0
M.MANHATTENSIS	0	0	0	0	0	0	0	0	0
M.LATERALIS	0	0	0	0	0	0	0	0	0
M.ARENARIA	0	0	0	0	0	0	0	0	0
M.EDULIS	0	0	0	0	0	0	0	0	0
N.OBSOLETUS	0	0	0	0	0	0	0	0	0
N.TRIVITATUS	0	0	0	0	0	0	0	0	0
N.VIBEX	0	0	0	0	0	0	0	0	0
N.TEXANA	13	33	19	0	35	27	0	1	0
N.PROXIMA	0	2	0	0	0	1	0	0	0
O.OCELLATUS	0	0	0	0	0	0	0	0	0
P.LONGICARPUS	0	0	0	3	0	0	0	0	0
P.GOULDIANA	0	0	0	0	0	0	0	0	0
P.PHOLADIFORMIS	0	0	0	0	0	0	0	0	0
P.MORRHAUNA	0	0	0	0	0	0	0	0	0
P.DUPLICATUS	0	0	0	0	0	0	0	0	0
S.VELUM	0	0	0	0	0	0	0	0	0
S.SOLIDISSIMA	0	0	0	0	0	0	0	0	0
T.PLEBEIUS	0	0	0	0	0	0	0	0	0
T.AGILUS	0	0	0	0	0	0	0	0	0
T.BRIAREUS	0	0	1	0	13	0	0	0	0
U.CINEREA	0	11	0	0	0	0	0	0	0
Y.LIMATULA	0	0	0	0	0	0	0	0	0

TONGED DATA SAMPLES

SPECIES	STATION								
	46F	46G	47A	47B	47C	47D	47E	47F	48A
A.IRRADIANS	0	0	0	0	0	0	0	0	0
A.OVALIS	0	0	0	0	0	0	0	0	0
A.TRANSVERSA	0	0	0	0	0	0	0	0	0
A.SIMPLEX	0	0	0	0	0	0	0	0	0
A.FORBESI	0	0	0	0	0	0	0	0	0
B.ALTERNATUM	0	0	0	0	0	0	0	0	0
B.CANALICULATUM	0	0	0	2	4	0	0	0	4
B.CARICA	0	0	0	0	0	0	0	0	0
C.SAPIDUS	0	0	0	0	0	0	0	1	0
C.IRRORATUS	0	0	0	0	0	0	0	0	0
C.VIRGINICA	0	0	0	0	0	0	0	0	0
C.CONVEXA	0	0	0	0	0	0	0	0	0
C.PLANA	0	0	0	0	0	0	0	0	0
E.DIRECTUS	0	0	160	1	2	0	0	0	18
E.CAUDATA	0	0	2	169	2	1	8	1	2
H.SOLITARIA	0	0	0	0	0	0	0	0	0
L.MORTONI	0	0	0	1	0	0	0	0	0
L.DUBIA	0	0	0	0	0	0	0	0	0
L.POLYPHEMUS	0	0	0	0	0	0	0	0	0
L.LITTOREA	0	0	0	0	0	0	0	0	0
L.HEROS	0	0	0	0	0	0	0	0	0
L.HYALINA	0	0	0	0	0	0	0	0	0
M.BALTHICA	0	0	1	0	0	0	0	0	0
M.TENTA	0	0	0	0	0	0	0	0	0
M.MERCENARIA	24	30	166	95	261	42	79	36	231
M.DEMISSUS	0	0	0	0	0	0	0	0	0
M.MANHATTENSIS	0	0	0	0	0	0	0	0	0
M.LATERALIS	0	0	1	0	0	0	0	0	0
M.ARENARIA	0	0	920	0	0	0	0	0	0
M.EDULIS	0	0	0	0	0	0	0	0	0
N.OBSOLETUS	0	0	0	0	0	0	0	0	0
N.TRIVITTATUS	0	0	0	0	0	0	0	0	0
N.VIBEX	0	0	0	0	0	0	0	0	0
N.TEXANA	0	0	1	20	37	7	5	14	0
N.PROXIMA	0	0	4	0	4	0	0	0	0
O.OCELLATUS	1	1	0	1	0	0	4	0	0
P.LONGICARPUS	2	1	0	0	0	0	4	2	0
P.GOULDIANA	0	0	0	0	0	0	0	0	0
P.PHOLADIFORMIS	0	0	0	0	0	0	0	0	0
P.MORRHAUNA	0	0	0	0	0	0	0	0	0
P.DUPLICATUS	0	0	0	0	0	0	0	0	0
S.VELUM	0	0	2	0	0	0	0	0	0
S.SOLIDISSIMA	0	1	0	0	0	0	0	0	0
T.PLEBEIUS	0	0	0	0	0	0	0	0	0
T.AGILIS	0	0	0	0	0	0	0	0	0
T.PRIAPEUS	1	0	1	1	0	0	0	6	2
U.CINEREA	3	1	0	1	0	0	0	1	0
Y.LIMATULA	0	0	0	0	0	0	0	0	0

TONGED DATA SAMPLES

SPECIES	STATION 48B	48C	48D	48E	48F	49A	49B	49C	49D
A.IRRADIANS	0	0	0	0	0	0	0	0	0
A.OVALIS	0	0	0	0	0	0	0	0	0
A.TRANSVERSA	0	0	0	0	0	0	0	0	0
A.SIMPLEX	0	0	0	0	0	0	0	0	0
A.FORBESI	0	0	0	0	0	0	0	0	0
B.ALTERNATUM	0	0	0	0	0	0	0	0	0
B.CANALICULATUM	2	1	0	0	0	1	1	0	0
B.CARICA	0	0	0	0	0	0	1	0	0
C.SAPIDUS	0	0	0	0	0	0	0	0	0
C.IRRORATUS	0	0	0	0	0	0	0	0	0
C.VIRGINICA	0	0	0	0	0	0	0	0	0
C.CONVEXA	0	0	0	0	0	0	0	20	12
C.PLANA	0	0	0	0	0	0	0	0	0
E.DIRECTUS	0	0	0	0	0	189	9	0	0
E.CAUDATA	0	16	0	0	0	0	1	7	0
H.SOLITARIA	0	0	0	0	0	0	0	0	0
L.MORTONI	0	0	0	0	0	0	0	0	0
L.DUBIA	0	0	0	0	0	0	1	0	0
L.POLYPHEMUS	0	0	0	0	2	0	2	1	0
L.LITTOREA	0	0	0	0	0	0	0	0	0
L.HEROS	0	0	0	0	0	0	0	0	0
L.HYALINA	0	0	0	0	0	0	0	0	0
M.BALTHICA	0	0	0	0	0	0	0	0	0
M.TENTA	0	0	0	0	0	0	0	0	0
M.MERCENARIA	212	70	86	44	21	545	142	65	54
M.DEMISSUS	0	0	0	0	0	0	0	0	0
M.MANHATTENSIS	0	0	0	0	0	0	0	0	0
M.LATERALIS	0	0	0	0	0	0	0	0	0
M.ARENARIA	0	0	0	0	0	200	0	0	0
M.EDULIS	0	0	0	0	0	0	0	0	0
N.OBSOLETUS	0	0	0	0	0	0	0	0	0
N.TRIVITATUS	0	0	0	0	0	0	0	0	0
N.VIBEX	0	0	0	0	0	0	0	0	0
N.TEXANA	11	11	2	5	0	2	6	32	0
N.PROXIMA	0	0	0	0	0	2	0	1	0
O.OCELLATUS	0	0	0	0	3	0	0	0	1
P.LONGICARPUS	0	0	0	0	0	0	0	0	1
P.GOULDIANA	0	0	0	0	0	0	0	0	0
P.PHOLADIFORMIS	0	0	0	0	0	0	0	0	0
P.MORRHAUNA	0	0	0	0	0	0	0	0	0
P.DUPLICATUS	0	0	0	0	0	0	0	0	0
S.VELUM	0	0	0	0	0	5	1	0	0
S.SOLIDISSIMA	0	0	0	0	0	0	0	0	0
T.PLEBEIUS	0	0	0	0	0	0	0	0	0
T.AGILUS	0	0	0	0	0	0	0	0	0
T.BRIAREUS	1	0	1	4	0	0	0	0	0
U.CINEREA	0	4	0	0	0	0	0	0	0
Y.LIMATULA	0	0	0	0	0	0	0	0	0

TONGED DATA SAMPLES

SPECIES	STATION 49E	50A	50B	50C	50D	50E	51A	51B	5
A.IRRADIANS	0	0	0	0	0	0	0	0	
A.OVALIS	0	0	0	0	0	0	0	0	
A.TRANSVERSA	0	0	0	0	0	0	0	0	
A.SIMPLEX	0	0	0	0	0	0	0	0	
A.FORBESI	0	0	0	0	0	0	0	0	
B.ALTERNATUM	0	0	0	0	0	0	0	0	
B.CANALICULATUM	0	7	0	0	0	0	2	1	
B.CARICA	0	0	0	0	0	0	0	0	
C.SAPIDUS	0	0	0	0	0	0	0	0	
C.IRRORATUS	0	0	0	0	0	0	0	0	
C.VIRGINICA	0	0	0	0	0	0	0	0	
C.CONVEXA	0	0	0	0	0	0	0	0	
C.PLANA	0	0	0	0	0	0	0	0	
E.DIRECTUS	0	25	1	0	0	0	13	0	
E.CAUDATA	0	0	0	0	0	1	0	0	
H.SOLITARIA	0	0	0	0	0	0	0	0	
L.MORTONI	0	0	0	0	0	0	0	0	
L.DUBIA	0	0	0	0	0	0	0	0	
L.POLYPHEMUS	0	0	0	1	0	2	0	1	
L.LITTOREA	0	0	0	0	0	0	0	0	
L.HEROS	0	0	0	0	0	0	0	0	
L.HYALINA	0	0	0	0	0	0	0	0	
M.BALTHICA	0	0	0	0	0	0	0	0	
M.TENTA	0	0	0	0	0	0	0	0	
M.MERCENARIA	24	395	97	104	45	11	67	77	
M.DEMISSUS	0	0	0	0	0	0	0	0	
M.MANHATTENSIS	0	0	0	0	0	0	0	0	
M.LATERALIS	0	0	0	0	0	0	0	0	
M.ARENARIA	0	0	1	0	0	0	24005	0	
M.EDULIS	0	0	0	0	0	0	10	0	
N.OBSOLETUS	0	0	0	0	0	0	0	0	
N.TRIVITATUS	0	0	0	0	0	0	0	0	
N.VIBEX	0	0	0	0	0	0	0	0	
N.TEXANA	1	17	12	9	0	2	0	20	
N.PROXIMA	0	3	0	1	0	0	0	0	
O.OCELLATUS	2	0	0	1	0	15	0	0	
P.LONGICARPUS	0	0	0	0	0	1	0	0	
P.GOULDIANA	0	0	0	1	0	0	0	0	
P.PHOLADIFORMIS	0	0	0	0	0	0	1	0	
P.MORRHUANA	0	0	0	0	0	0	0	0	
P.DUPLICATUS	0	0	0	0	0	0	0	0	
S.VELUM	0	0	0	0	0	0	1	0	
S.SOLIDISSIMA	0	0	0	0	0	1	0	0	
T.PLEBEIUS	0	0	0	0	0	0	0	0	
T.AGILUS	0	0	0	0	0	0	0	0	
T.BRIAREUS	0	1	1	3	0	0	0	0	
U.CINEREA	0	1	0	1	0	0	0	0	
Y.LIMATULA	0	0	0	0	0	0	0	0	

TONGED DATA SAMPLES

SPECIES	STATION								
	51D	52A	52B	52C	52D	53A	53B	53C	54A
A.IRRADIANS	0	0	0	0	0	0	0	0	0
A.OVALIS	0	0	0	0	0	0	0	0	0
A.TRANSVERSA	0	0	0	0	0	0	0	0	0
A.SIMPLEX	0	0	0	0	0	0	0	0	0
A.FORBESI	0	0	0	0	0	0	0	0	0
B.ALTERNATUM	0	0	0	0	0	0	0	0	0
B.CANALICULATUM	0	2	0	0	0	0	0	0	5
B.CARICA	0	0	0	0	0	0	0	0	0
C.SAPIDUS	0	0	0	0	0	0	0	0	0
C.IRRORATUS	0	0	0	0	0	0	0	0	0
C.VIRGINICA	0	11	0	0	0	0	0	0	0
C.CONVEXA	0	100	0	0	0	0	0	0	0
C.PLANA	0	0	0	0	0	0	0	0	0
E.DIRECTUS	0	0	0	0	0	1	0	0	6
E.CAUDATA	0	1	0	0	0	1	1	0	1
H.SOLITARIA	0	0	0	0	0	0	0	0	0
L.MORTONI	0	0	0	0	0	0	0	0	0
L.DUBIA	0	0	0	0	0	0	0	0	0
L.POLYPHEMUS	1	0	0	0	0	0	0	0	0
L.LITTOREA	0	0	0	0	0	0	0	0	0
L.HEROS	0	0	0	0	0	0	0	0	0
L.HYALINA	0	0	0	0	0	0	0	0	1
M.BALTHICA	0	0	0	0	22	0	0	0	0
M.TENTA	0	0	0	0	0	0	0	0	0
M.MERCENARIA	1	189	101	50	1	202	53	36	19
M.DEMISSUS	0	0	0	0	0	0	0	0	0
M.MANHATTENSIS	0	0	0	0	0	0	0	0	0
M.LATERALIS	0	0	0	0	0	0	0	0	0
M.ARENARIA	64	0	0	0	53	1	0	0	0
M.EDULIS	0	0	0	0	0	0	0	0	0
N.OBSOLETUS	0	0	0	0	0	0	0	0	0
N.TRIVITATUS	0	0	0	0	0	0	0	0	0
N.VIBEX	0	0	0	0	0	0	0	0	0
N.TEXANA	0	6	6	3	0	13	7	3	0
N.PROXIMA	0	0	0	0	0	0	0	0	0
O.OCELLATUS	1	0	0	0	0	0	0	1	0
P.LONGICARPUS	0	0	0	0	0	0	0	0	0
P.GOULDIANA	0	0	0	0	0	0	0	0	0
P.PHOLADIFORMIS	2	0	0	0	0	0	0	0	1
P.MORRHAUNA	0	0	0	0	0	0	0	0	0
P.DUPLICATUS	0	0	1	0	0	0	0	0	0
S.VELUM	0	0	0	0	0	0	0	0	0
S.SOLIDISSIMA	0	0	0	0	0	0	0	0	0
T.PLEBEIUS	0	0	0	0	0	0	0	0	0
T.AGILUS	0	0	0	0	0	0	0	0	0
T.BRIAREUS	0	2	6	2	0	0	2	0	0
U.CINEREA	0	0	0	0	0	0	0	0	3
Y.LIMATULA	0	0	0	0	0	0	0	0	0

TONGED DATA SAMPLES

SPECIES	STATION								
	54B	54C	54D ✓	55A	55B	55C	55D ✓	56A	56B
A.IRRADIANS	0	0	0	0	0	0	0	0	0
A.OVALIS	0	0	0	0	0	0	0	0	0
A.TRANSVERSA	0	0	0	0	0	0	0	0	0
A.SIMPLEX	0	0	0	0	0	0	0	0	0
A.FORBESI	0	0	0	0	0	0	0	0	0
B.ALTERNATUM	0	0	0	0	0	0	0	0	0
B.CANALICULATUM	0	0	0	2	0	0	0	1	0
B.CARICA	0	0	0	0	0	0	0	0	0
C.SAPIDUS	0	0	0	0	0	0	0	0	0
C.IRRORATUS	0	0	0	0	0	0	0	0	0
C.VIRGINICA	0	0	0	0	0	0	0	0	0
C.CONVEXA	0	0	0	0	0	0	0	0	0
C.PLANA	0	0	0	0	0	0	0	0	0
E.DIRECTUS	2	0	1	0	0	1	0	0	0
E.CAUDATA	0	0	0	1	0	0	0	0	0
H.SOLITARIA	0	0	0	0	0	0	0	0	0
L.MORTONI	0	0	0	0	0	0	0	0	0
L.DUBIA	0	0	0	0	0	1	0	0	0
L.POLYPHEMUS	1	0	0	2	0	0	4	0	0
L.LITTOREA	0	0	0	0	0	0	0	0	0
L.HEROS	0	0	0	0	0	0	0	0	0
L.HYALINA	0	0	0	0	0	0	0	1	0
M.BALTHICA	0	0	0	0	0	0	0	0	0
M.TENTA	0	0	0	0	0	0	0	0	0
M.MERCENARIA	55	1	4	67	35	21	32	51	35
M.DEMISSUS	0	0	0	0	0	0	0	0	0
M.MANHATTENSIS	0	0	0	0	0	0	0	0	0
M.LATERALIS	0	0	0	0	0	0	0	0	0
M.ARENARIA	0	0	0	0	0	0	0	0	0
M.EDULIS	0	0	0	0	0	0	0	0	0
N.OBSOLETUS	0	0	0	0	0	0	0	0	0
N.TRIVITTATUS	0	0	0	0	0	0	0	0	0
N.VIBEX	0	0	0	0	0	0	0	0	0
N.TEXANA	0	2	0	9	1	2	4	1	1
N.PROXIMA	0	0	0	0	0	0	0	0	0
O.OCELLATUS	0	0	0	0	0	0	0	1	0
P.LONGICARPUS	0	0	0	0	0	0	0	0	0
P.GOULDIANA	0	0	0	0	0	0	0	0	0
P.PHOLADIFORMIS	0	0	0	0	0	0	0	0	0
P.MORRHAUNA	0	0	0	0	0	0	0	0	0
P.DUPLICATUS	0	0	0	0	0	0	0	0	0
S.VELUM	0	0	0	0	0	3	3	0	0
S.SOLIDISSIMA	0	0	0	0	0	0	0	0	0
T.PLEBEIUS	0	0	0	0	0	0	0	0	0
T.AGILIS	0	0	0	0	0	0	0	0	0
T.BRIAREUS	2	0	0	0	3	0	1	0	1
U.CINEREA	0	0	0	7	0	0	0	0	0
Y.LIMATULA	0	0	0	0	0	0	0	0	0

TONGED DATA SAMPLES

SPECIES	STATION								
	56C	56D	56E	57A	57B	57C	57D	58A	58B
A.IRRADIANS	0	0	0	0	0	0	0	0	0
A.OVALIS	0	0	0	0	0	0	0	0	0
A.TRANSVERSA	0	0	0	0	0	0	0	0	0
A.SIMPLEX	0	0	0	0	0	0	0	0	0
A.FORBESI	0	0	0	0	0	0	0	0	0
B.ALTERNATUM	0	0	0	0	0	0	0	0	0
B.CANALICULATUM	0	0	0	0	0	0	0	2	0
B.CARICA	0	0	0	0	0	0	0	0	0
C.SAPIDUS	0	0	0	0	0	0	0	0	0
C.IRRORATUS	0	0	0	0	0	0	0	0	0
C.VIRGINICA	0	0	0	0	0	0	0	0	0
C.CONVEXA	0	0	0	0	0	0	0	0	0
C.PLANA	0	0	0	0	0	0	0	0	0
E.DIRECTUS	0	0	0	0	0	0	0	1	0
E.CAUDATA	0	0	0	0	0	0	1	11	0
H.SOLITARIA	0	0	0	0	0	0	0	0	0
L.MORTONI	0	0	0	0	0	0	0	0	0
L.DUBIA	0	0	1	0	0	0	0	0	1
L.POLYPHEMUS	0	0	0	1	0	0	0	1	2
L.LITTOREA	0	0	0	0	0	0	0	0	0
L.HEROS	0	0	0	0	0	0	0	0	0
L.HYALINA	0	0	0	0	0	0	0	0	0
M.BALTHICA	0	0	0	0	0	0	0	0	0
M.TENTA	0	0	0	0	0	0	0	0	0
M.MERCENARIA	38	39	24	67	79	20	38	62	57
M.DEMISSUS	0	0	0	0	0	0	0	0	0
M.MANHATTENSIS	0	0	0	0	0	0	0	0	0
M.LATERALIS	0	0	0	0	0	0	0	0	0
M.ARENARIA	0	0	0	0	0	0	0	0	0
M.EDULIS	0	0	0	0	0	0	0	0	0
N.OBSOLETUS	0	0	0	0	0	0	0	0	0
N.TRIVITATUS	0	0	0	0	0	0	0	0	0
N.VIBEX	0	0	0	0	0	0	0	0	0
N.TEXANA	3	5	10	0	2	0	1	1	1
N.PROXIMA	0	0	0	0	0	0	0	0	0
O.OCELLATUS	0	0	0	0	0	0	8	2	0
P.LONGICARPUS	0	0	0	0	0	0	0	0	0
P.GOULDIANA	0	0	0	0	0	0	0	0	0
P.PHOLADIFORMIS	0	0	0	0	0	0	0	0	0
P.MORRHAUNA	0	0	0	0	0	0	0	0	0
P.DUPLICATUS	0	0	0	0	0	0	0	0	0
S.VELUM	12	5	32	0	0	0	4	0	0
S.SOLIDISSIMA	0	0	0	0	0	0	1	0	0
T.PLEBEIUS	0	0	0	0	0	0	0	0	0
T.AGILUS	0	0	0	0	0	0	0	0	0
T.BRIAREUS	7	0	13	0	3	4	0	0	4
U.CINEREA	0	0	4	1	0	0	0	1	0
Y.LIMATULA	0	0	0	0	0	0	0	0	0

TONGED DATA SAMPLES

SPECIES	STATION 58C	58D	58E	58F	59A	59B	59C	59D	60A
A.IRRADIANS	0	0	0	0	0	0	0	3	0
A.OVALIS	0	0	0	0	0	0	0	0	0
A.TRANSVERSA	0	0	0	0	0	0	0	0	0
A.SIMPLEX	0	0	0	0	0	0	0	0	0
A.FORBESI	0	0	0	0	0	0	0	0	0
B.ALTERNATUM	0	0	0	0	0	0	0	0	0
B.CANALICULATUM	0	0	2	0	3	1	2	1	0
B.CARICA	0	0	0	0	0	0	0	0	0
C.SAPIDUS	0	0	0	0	0	0	0	0	0
C.IRRORATUS	0	0	0	0	0	0	0	10	0
C.VIRGINICA	0	0	0	0	0	0	0	0	0
C.CONVEXA	0	50	0	0	0	0	12	0	0
C.PLANA	0	33	0	0	0	0	0	0	0
E.DIRECTUS	0	0	2	3	0	1	1	2	0
E.CAUDATA	5	0	118	7	8	0	1	1	0
H.SOLITARIA	0	0	0	0	0	0	0	0	0
L.MORTONI	0	0	0	0	0	0	0	0	0
L.DUBIA	0	0	0	0	0	0	0	0	0
L.POLYPHEMUS	2	1	0	2	0	0	5	0	0
L.LITTOREA	0	0	0	0	0	0	0	0	0
L.HEROS	0	0	0	0	0	0	0	0	0
L.HYALINA	0	0	0	0	0	0	0	0	0
M.BALTHICA	0	0	0	0	0	0	0	0	0
M.TENTA	0	0	0	0	0	0	0	0	0
M.MERCENARIA	1	5	45	153	118	75	28	38	0
M.DEMISSUS	0	0	0	0	0	0	0	0	0
M.MANHATTENSIS	0	0	0	0	0	0	0	0	0
M.LATERALIS	0	0	0	0	0	0	0	0	0
M.ARENARIA	0	0	0	0	0	0	0	0	0
M.EDULIS	0	0	0	0	0	0	0	0	0
N.OBSOLETUS	0	0	0	0	0	0	8	0	[illegible]
N.TRIVITTATUS	0	0	0	0	0	0	0	0	0
N.VIBEX	0	0	0	0	0	0	0	0	0
N.TEXANA	6	0	0	4	2	6	1	1	0
N.PROXIMA	0	0	0	0	0	0	0	0	0
O.OCELLATUS	0	0	0	0	0	0	10	0	0
P.LONGICARPUS	0	0	0	0	0	0	1	1	0
P.GOULDIANA	0	0	0	0	0	0	0	0	0
P.PHOLADIFORMIS	0	0	0	0	0	0	0	0	0
P.MORRHAUNA	0	0	0	0	0	0	0	2	0
P.DUPLICATUS	0	0	0	0	1	0	0	0	0
S.VELUM	0	0	9	9	0	8	0	23	0
S.SOLIDISSIMA	0	0	0	0	0	0	0	0	0
T.PLEBEIUS	0	0	0	0	0	0	0	0	0
T.AGILUS	0	0	0	0	0	0	0	0	0
T.BRIAREUS	0	0	0	2	0	3	0	6	0
U.CINEREA	0	0	13	25	0	2	0	1	0
Y.LIMATULA	0	0	0	0	0	0	0	0	0

TONGED DATA SAMPLES

SPECIES	STATION 60B	60C	60D	60E	60F	60G	61A	61B	61C
A.IRRADIANS	0	0	0	0	0	0	0	0	0
A.OVALIS	0	0	0	0	0	0	0	0	0
A.TRANSVERSA	0	0	0	0	0	0	0	0	0
A.SIMPLEX	0	0	0	0	0	0	0	0	0
A.FORBESI	0	0	0	0	0	0	0	0	0
B.ALTERNATUM	0	0	0	0	0	0	0	0	0
B.CANALICULATUM	0	0	0	0	0	0	0	0	0
B.CARICA	0	0	0	0	0	0	0	0	0
C.SAPIDUS	0	0	0	0	0	0	1	0	0
C.IRRORATUS	0	0	0	0	0	0	0	0	1
C.VIRGINICA	0	0	0	0	0	0	0	0	0
C.CONVEXA	44	0	16	0	0	10	0	0	0
C.PLANA	0	0	0	0	0	0	0	0	0
E.DIRECTUS	0	0	1	0	0	0	2	0	0
E.CAUDATA	0	0	0	0	0	1	0	1	1
H.SOLITARIA	0	0	0	0	0	0	0	0	0
L.MORTONI	0	0	0	0	0	0	0	0	0
L.DUBIA	0	2	0	0	0	0	0	0	0
L.POLYPHEMUS	0	1	2	1	0	1	1	0	0
L.LITTOREA	0	0	0	0	0	0	0	0	0
L.HEROS	0	0	0	0	0	0	0	0	0
L.HYALINA	0	0	0	0	0	1	0	0	0
M.BALTHICA	0	0	0	0	0	0	0	0	0
M.TENTA	0	0	0	0	0	0	0	0	0
M.MERCENARIA	5	59	28	5	12	30	90	14	19
M.DEMISSUS	0	0	0	0	0	0	0	0	0
M.MANHATTENSIS	0	0	0	0	0	0	0	0	0
M.LATERALIS	0	0	0	0	0	0	0	0	0
M.ARENARIA	0	0	0	0	0	0	0	0	0
M.EDULIS	0	0	0	0	0	0	0	0	0
N.OBSOLETUS	1	0	0	0	0	0	0	0	0
N.TRIVITATUS	0	0	0	0	0	0	0	0	0
N.VIBEX	0	0	0	0	0	0	0	0	0
N.TEXANA	0	4	0	0	0	0	0	1	1
N.PROXIMA	0	0	0	0	0	0	0	0	0
O.OCELLATUS	4	0	0	0	0	4	0	0	10
P.LONGICARPUS	0	0	0	0	0	6	0	0	0
P.GOULDIANA	0	0	0	0	0	0	0	0	0
P.PHOLADIFORMIS	0	0	0	0	0	0	0	0	0
P.MORRHAUNA	0	0	0	0	0	0	0	0	1
P.DUPLICATUS	0	0	0	0	0	0	0	0	0
S.VELUM	0	0	0	0	0	0	0	0	1
S.SOLIDISSIMA	0	0	0	0	0	0	0	0	0
T.PLEBEIUS	0	0	0	0	0	0	0	0	0
T.AGILUS	0	0	0	0	0	0	0	0	0
T.BRIAREUS	0	0	0	4	0	0	0	0	0
U.CINEREA	0	2	1	0	0	0	1	2	0
Y.LIMATULA	0	0	0	0	0	0	0	0	0

TOWN OF BABYLON - HARD CLAM STUDY (1985)
SUMMARY OF SAMPLE DATA

STATION NUMBER	NORTH LATITUDE	WEST LONGITUDE	SEED CLAMS	LITTLENECK CLAMS	CHERRYSTONE CLAMS	CHOWDER CLAMS	MUD CRABS	OTHER PREDATORS	DEAD CLAMS	WATER CERTIFICATION
85	40 39.38	73 18.05	3	5	1	0	9	1	0	CERTIFIED
86	40 39.38	73 18.20	11	2	1	1	32	0	0	CERTIFIED
87	40 39.53	73 18.19	3	2	1	2	23	0	0	CERTIFIED
88	40 39.67	73 18.20	2	0	0	0	57	0	0	CERTIFIED
89	40 39.81	73 18.19	1	2	1	0	10	0	0	CERTIFIED
90	40 39.94	73 18.20	0	1	0	1	4	0	1	CERTIFIED
91	40 40.09	73 18.20	0	3	0	1	3	0	0	CERTIFIED
92	40 40.25	73 18.20	1	6	1	1	42	0	1	CERTIFIED
93	40 40.40	73 18.21	1	3	0	0	11	2	0	UNCERTIFIED
94	40 40.54	73 18.20	2	6	4	2	3	0	0	UNCERTIFIED
95	40 40.66	73 18.26	0	4	1	1	0	0	0	UNCERTIFIED
96	40 40.65	73 18.42	0	1	2	3	2	0	0	UNCERTIFIED
97	40 40.50	73 18.42	6	5	5	0	28	0	0	UNCERTIFIED
98	40 40.39	73 18.41	0	1	2	2	42	2	0	UNCERTIFIED
99	40 40.26	73 18.41	1	5	3	0	102	1	0	UNCERTIFIED
100	40 40.09	73 18.40	0	4	1	2	13	0	1	CERTIFIED
101	40 39.95	73 18.40	2	0	0	0	4	1	0	CERTIFIED
102	40 39.80	73 18.39	1	1	2	2	2	0	0	CERTIFIED
103	40 39.69	73 18.40	5	1	6	1	13	1	0	CERTIFIED
104	40 39.53	73 18.39	2	0	1	0	39	1	0	CERTIFIED
105	40 39.41	73 18.38	1	1	2	2	26	0	0	CERTIFIED
106	40 39.39	73 18.53	0	0	0	1	20	0	0	CERTIFIED
107	40 39.51	73 18.54	1	1	3	0	26	0	0	CERTIFIED
108	40 39.66	73 18.54	3	4	3	0	14	0	0	CERTIFIED
109	40 39.80	73 18.54	12	0	0	0	6	0	0	CERTIFIED
110	40 39.94	73 18.53	3	2	1	0	2	0	3	CERTIFIED
111	40 40.09	73 18.54	2	1	0	0	0	0	0	CERTIFIED
112	40 40.24	73 18.55	0	1	0	2	0	1	0	UNCERTIFIED

TOWN OF BABYLON - HARD CLAM STUDY (1985)
SUMMARY OF SAMPLE DATA

STATION NUMBER	NORTH LATITUDE	WEST LONGITUDE	SEED CLAMS	LITTLENECK CLAMS	CHERRYSTONE CLAMS	CHOWDER CLAMS	MUD CRABS	OTHER PREDATORS	DEAD CLAMS	WATER CERTIFICATION
113	40 40.37	73 18.55	0	3	4	2	4	0	0	UNCERTIFIED
114	40 40.49	73 18.54	5	3	3	2	2	1	0	UNCERTIFIED
115	40 40.62	73 18.56	0	0	0	0	1	1	0	UNCERTIFIED
116	40 40.62	73 18.72	0	4	4	4	4	0	0	UNCERTIFIED
117	40 40.48	73 18.74	2	3	2	1	1	0	0	UNCERTIFIED
118	40 40.35	73 18.72	0	5	4	3	19	0	0	UNCERTIFIED
119	40 40.25	73 18.72	0	2	3	3	0	0	1	UNCERTIFIED
120	40 40.12	73 18.73	2	4	0	2	9	1	0	UNCERTIFIED
121	40 39.98	73 18.72	0	0	0	1	0	0	0	CERTIFIED
122	40 39.84	73 18.73	0	3	1	2	0	2	0	CERTIFIED
123	40 39.71	73 18.70	1	0	0	1	2	0	0	CERTIFIED
124	40 39.57	73 18.71	3	3	3	3	10	0	1	CERTIFIED
125	40 39.37	73 18.96	0	0	1	1	3	2	0	CERTIFIED
126	40 39.36	73 18.86	3	2	2	1	7	2	0	CERTIFIED
127	40 39.53	73 18.86	1	1	0	2	10	1	0	CERTIFIED
128	40 39.66	73 18.87	3	2	0	1	2	0	0	CERTIFIED
129	40 39.82	73 18.86	1	1	1	0	4	1	0	CERTIFIED
130	40 39.97	73 18.86	0	0	1	1	1	0	2	CERTIFIED
131	40 40.13	73 18.86	0	3	3	4	1	0	5	UNCERTIFIED
132	40 40.25	73 18.87	0	0	6	6	0	0	1	UNCERTIFIED
133	40 40.37	73 18.87	0	9	2	3	6	1	0	UNCERTIFIED
134	40 40.52	73 18.88	1	2	0	2	0	0	0	UNCERTIFIED
135	40 40.63	73 18.89	2	3	1	1	0	0	2	UNCERTIFIED
136	40 40.62	73 19.13	2	15	5	2	27	1	0	UNCERTIFIED
137	40 40.53	73 19.14	2	3	1	0	0	1	0	UNCERTIFIED
138	40 40.40	73 19.14	1	11	3	1	33	0	0	UNCERTIFIED
139	40 40.27	73 19.14	0	3	2	6	1	0	0	UNCERTIFIED
140	40 40.12	73 19.14	0	1	2	2	0	0	0	UNCERTIFIED

TOWN OF BABYLON - HARD CLAM STUDY (1985)
SUMMARY OF SAMPLE DATA

STATION NUMBER	NORTH LATITUDE	WEST LONGITUDE	SEED CLAMS	LITTLENECK CLAMS	CHERRYSTONE CLAMS	CHOWDER CLAMS	MUD CRABS	OTHER PREDATORS	DEAD CLAMS	WATER CERTIFICATION
141	40 39.96	73 19.15	0	1	2	1	4	1	0	CERTIFIED
142	40 39.80	73 19.13	1	4	0	0	3	2	2	CERTIFIED
143	40 39.64	73 19.15	4	2	2	0	6	0	0	CERTIFIED
144	40 39.46	73 19.15	4	1	2	6	8	0	0	CERTIFIED
145	40 39.30	73 19.16	2	6	0	1	7	1	0	CERTIFIED
146	40 39.26	73 19.34	0	0	0	2	3	0	0	CERTIFIED
147	40 39.43	73 19.37	0	3	2	1	9	0	1	CERTIFIED
148	40 39.61	73 19.36	2	2	0	1	5	0	0	CERTIFIED
149	40 39.77	73 19.37	1	2	1	1	1	1	0	CERTIFIED
150	40 39.92	73 19.36	0	2	1	2	24	3	0	CERTIFIED
151	40 40.08	73 19.37	0	1	3	4	4	0	0	UNCERTIFIED
152	40 40.24	73 19.38	0	4	3	4	2	2	1	UNCERTIFIED
153	40 40.38	73 19.39	0	0	2	0	0	0	0	UNCERTIFIED
154	40 40.53	73 19.38	0	1	2	2	0	0	1	UNCERTIFIED
155	40 40.66	73 19.39	0	1	3	3	0	1	2	UNCERTIFIED
156	40 40.63	73 19.57	1	4	3	3	2	0	1	UNCERTIFIED
157	40 40.51	73 19.58	0	4	4	3	0	0	1	UNCERTIFIED
158	40 40.36	73 19.59	0	0	0	1	1	0	0	UNCERTIFIED
159	40 40.24	73 19.59	0	4	1	4	0	0	1	UNCERTIFIED
160	40 40.10	73 19.57	0	3	6	18	3	1	0	UNCERTIFIED
161	40 39.94	73 19.57	0	0	1	2	0	0	0	CERTIFIED
162	40 39.78	73 19.56	0	0	1	1	14	1	0	CERTIFIED
163	40 39.61	73 19.58	1	1	0	0	1	1	0	CERTIFIED
164	40 39.46	73 19.57	2	0	1	0	4	0	0	CERTIFIED
165	40 39.30	73 19.59	3	3	3	2	11	0	0	CERTIFIED
166	40 39.27	73 19.78	0	1	0	0	13	0	0	CERTIFIED
167	40 39.42	73 19.79	2	3	0	2	7	1	0	CERTIFIED
168	40 39.58	73 19.80	35	2	2	2	6	1	0	CERTIFIED

TOWN OF BABYLON - HARD CLAM STUDY (1985)
SUMMARY OF SAMPLE DATA

STATION NUMBER	NORTH LATITUDE	WEST LONGITUDE	SEED CLAMS	LITTLENECK CLAMS	CHERRYSTONE CLAMS	CHOWDER CLAMS	MUD CRABS	OTHER PREDATORS	DEAD CLAMS	WATER CERTIFICATION
169	40 39.76	73 19.81	1	3	2	3	2	0	0	CERTIFIED
170	40 39.92	73 19.80	0	2	3	4	7	1	0	UNCERTIFIED
171	40 40.09	73 19.81	0	3	4	5	3	0	0	UNCERTIFIED
172	40 40.19	73 19.79	0	0	0	0	0	0	0	UNCERTIFIED
173	40 40.35	73 19.79	0	2	5	8	64	1	0	UNCERTIFIED
174	40 40.45	73 19.79	0	0	3	2	11	1	0	UNCERTIFIED
175	40 40.46	73 19.96	0	1	0	4	70	0	0	UNCERTIFIED
176	40 40.31	73 19.97	0	2	2	3	21	0	0	UNCERTIFIED
177	40 40.18	73 19.95	0	1	0	3	1	0	0	UNCERTIFIED
178	40 40.05	73 19.98	0	7	2	3	0	1	1	UNCERTIFIED
179	40 39.89	73 19.98	0	0	1	9	2	0	0	UNCERTIFIED
180	40 39.71	73 19.96	0	0	1	3	14	1	0	CERTIFIED
181	40 39.57	73 19.97	0	4	0	4	11	0	0	CERTIFIED
182	40 39.41	73 19.96	0	1	3	2	5	0	0	CERTIFIED
183	40 39.26	73 19.97	2	1	4	1	7	0	0	CERTIFIED
184	40 39.12	73 19.95	0	3	2	0	11	0	0	CERTIFIED
185	40 39.10	73 20.14	1	2	0	0	9	1	0	CERTIFIED
186	40 39.27	73 20.16	3	2	0	2	1	0	0	CERTIFIED
187	40 39.41	73 20.16	5	1	0	3	6	3	0	CERTIFIED
188	40 39.57	73 20.17	0	1	1	3	0	0	0	CERTIFIED
189	40 39.72	73 20.15	0	0	0	2	14	1	0	CERTIFIED
190	40 39.89	73 20.16	0	2	4	4	2	0	0	UNCERTIFIED
191	40 40.02	73 20.15	0	0	1	3	0	0	0	UNCERTIFIED
192	40 40.17	73 20.14	1	1	1	3	16	1	0	UNCERTIFIED
193	40 40.17	73 20.31	0	0	0	0	1	0	0	UNCERTIFIED
194	40 40.02	73 20.32	0	2	1	1	0	1	0	UNCERTIFIED
195	40 39.87	73 20.31	1	2	4	5	1	1	0	UNCERTIFIED
196	40 39.71	73 20.31	0	1	2	2	4	3	1	CERTIFIED

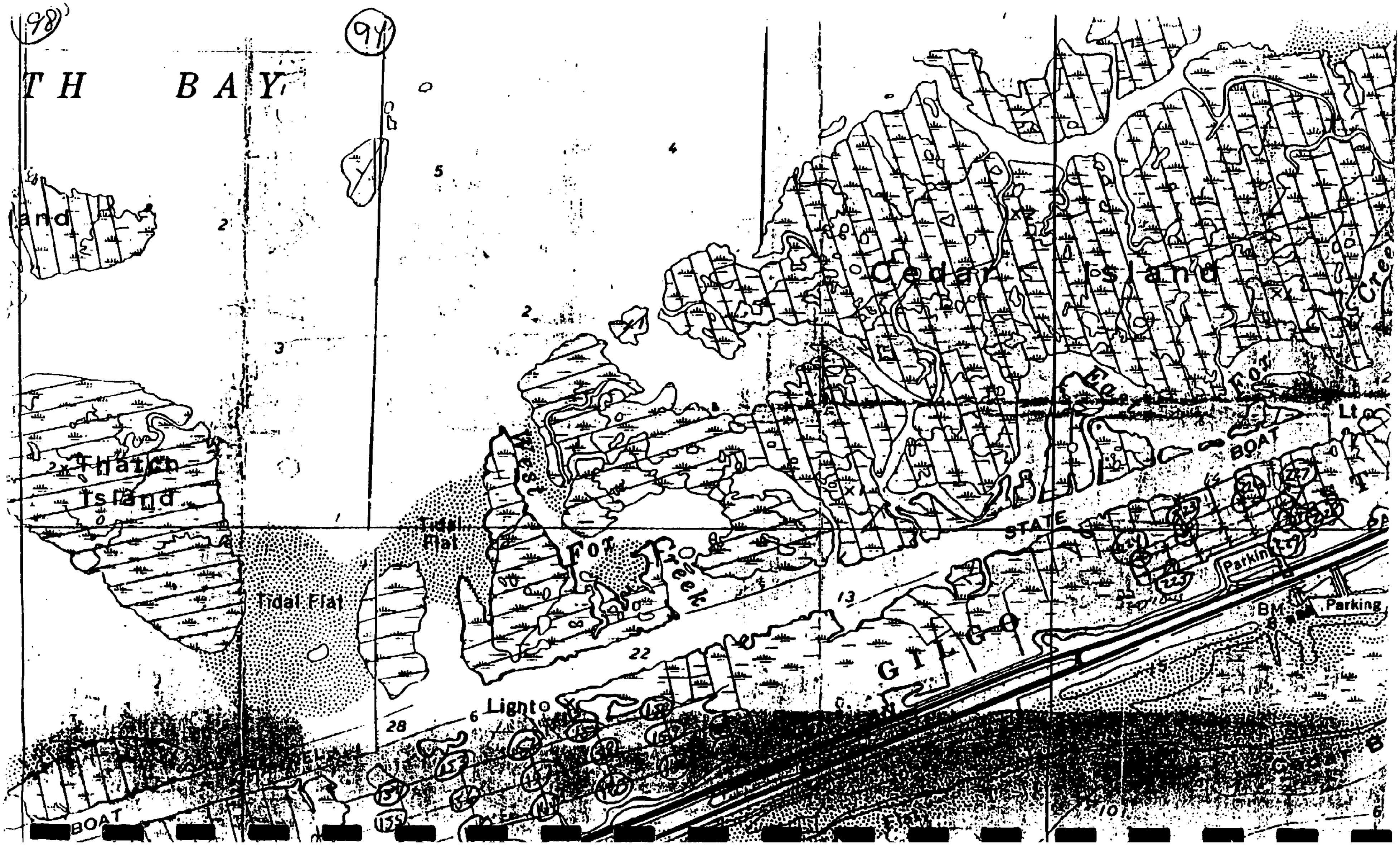
TOWN OF BABYLON - HARD CLAM STUDY (1985)
SUMMARY OF SAMPLE DATA

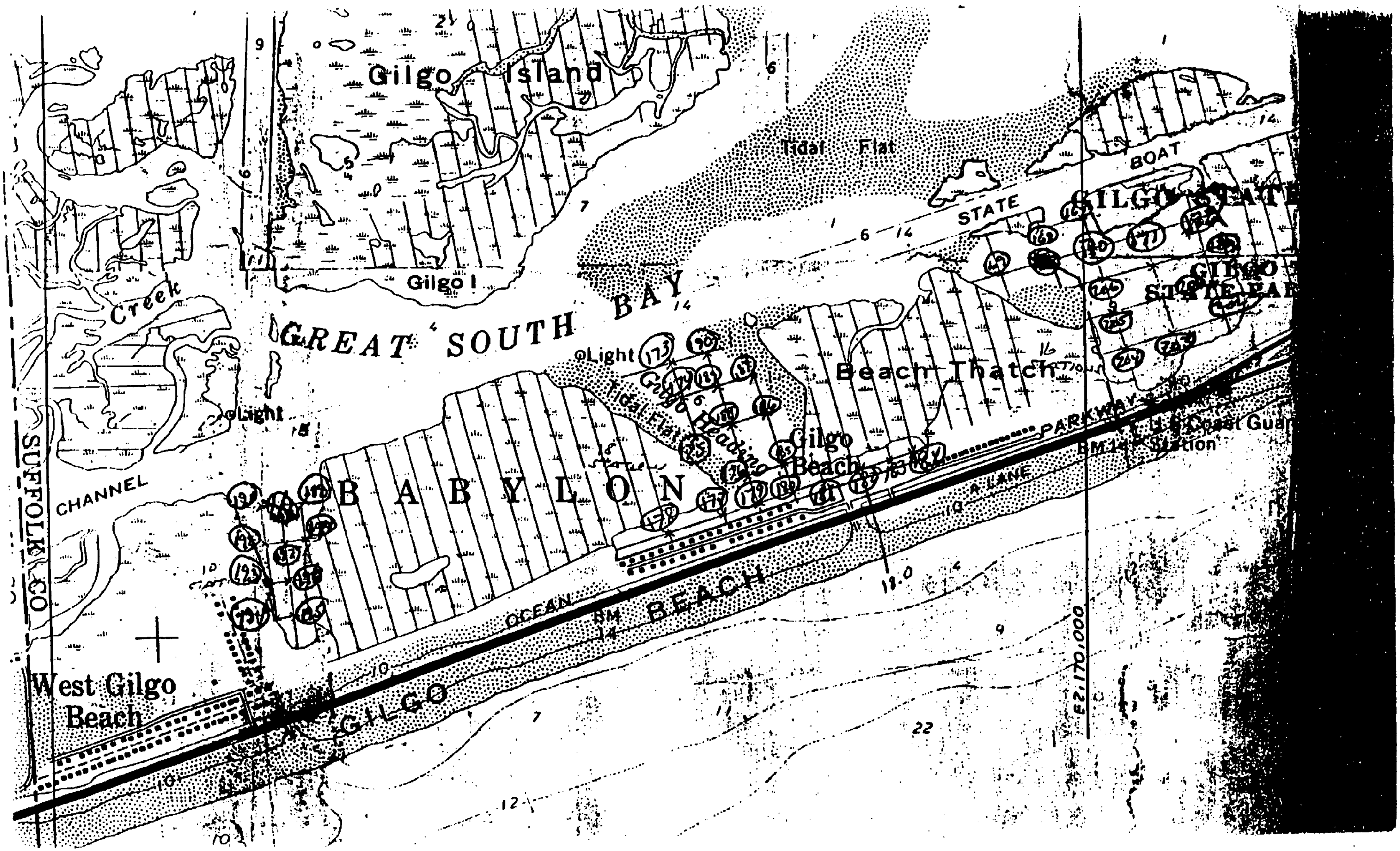
STATION NUMBER	NORTH LATITUDE	WEST LONGITUDE	SEED CLAMS	LITTLENECK CLAMS	CHERRYSTONE CLAMS	CHOWDER CLAMS	MUD CRABS	OTHER PREDATORS	DEAD CLAMS	WATER CERTIFICATION
197	40 39.56	73 20.32	2	6	4	4	0	1	0	CERTIFIED
198	40 39.40	73 20.32	0	1	1	3	6	0	0	CERTIFIED
199	40 39.24	73 20.33	0	1	1	3	13	0	0	CERTIFIED
200	40 39.10	73 20.31	0	0	0	3	10	2	0	CERTIFIED
201	40 39.09	73 20.48	0	0	0	0	8	4	0	CERTIFIED
202	40 39.24	73 20.47	0	0	0	0	0	9	0	CERTIFIED
203	40 39.39	73 20.47	0	0	1	2	10	3	0	CERTIFIED
204	40 39.53	73 20.48	0	0	1	4	3	0	0	CERTIFIED
205	40 39.69	73 20.47	1	1	2	7	0	0	0	CERTIFIED
206	40 39.84	73 20.49	0	3	0	0	2	1	0	UNCERTIFIED
207	40 40.00	73 20.51	0	0	0	0	2	1	0	UNCERTIFIED
208	40 40.13	73 20.50	0	0	0	0	1	0	1	UNCERTIFIED
209	40 40.29	73 20.57	0	0	0	0	2	0	0	UNCERTIFIED
210	40 40.02	73 20.68	0	2	1	3	0	1	0	UNCERTIFIED
211	40 40.02	73 20.84	0	3	1	0	0	1	0	UNCERTIFIED
212	40 40.01	73 21.07	0	1	2	4	59	0	0	UNCERTIFIED
213	40 39.85	73 20.65	0	1	2	3	5	1	0	UNCERTIFIED
214	40 39.69	73 20.66	0	1	0	1	34	0	0	CERTIFIED
215	40 39.52	73 20.68	0	0	0	5	15	0	1	CERTIFIED
216	40 39.37	73 20.65	0	0	0	5	10	0	0	CERTIFIED
217	40 39.24	73 20.66	0	1	1	4	19	0	0	CERTIFIED
218	40 39.10	73 20.67	0	0	0	5	10	2	0	CERTIFIED
219	40 39.09	73 20.86	0	0	0	4	22	1	0	CERTIFIED
220	40 39.24	73 20.84	0	0	2	1	14	0	0	CERTIFIED
221	40 39.39	73 20.83	0	0	0	2	8	0	0	CERTIFIED
222	40 39.55	73 20.84	0	1	2	2	2	0	0	CERTIFIED
223	40 39.70	73 20.84	0	2	1	4	1	1	0	UNCERTIFIED
224	40 39.91	73 20.85	0	0	0	0	0	1	2	UNCERTIFIED

TOWN OF BABYLON - HARD CLAM STUDY (1986)
SUMMARY OF SAMPLE DATA

STATION NUMBER	NORTH LATITUDE	WEST LONGITUDE	SEED CLAMS	LITTLENECK CLAMS	CHERRYSTONE CLAMS	CHOWDER CLAMS	MUD CRABS	OTHER PREDATORS	DEAD CLAMS	WATER CERTIFICATION
225	40 38.02	73 20.56	3	3	0	2	0	0	0	UNCERTIFIED
226	40 38.15	73 20.38	6	1	0	0	0	2	1	UNCERTIFIED
227 *	40 38.13	73 20.27	108	12	2	3	0	0	1	UNCERTIFIED
228 *	40 38.13	73 20.27	20	4	1	1	0	0	2	UNCERTIFIED
229 *	40 38.11	73 20.30	547	9	2	4	20	1	7	UNCERTIFIED
230 *	40 38.11	73 20.26	11	6	3	1	2	0	4	UNCERTIFIED

* Station not included in statistical analysis.


98
97
TH BAY
Cedar Island
Thatch Island
Tidal Flat
Tidal Flat
West Fox Creek
East Fox Creek
GILGO
STATE
BOAT
BOAT
Parking
Parking
BM
Lt
Lighto



Gilgo Island
Tidal Flat
BOAT
STATE
Gilgo I
GREAT SOUTH BAY
Light
Light
Creek
CHANNEL
Tidal Flat
Beach Thatch
Gilgo Beach
BABYLON
PARKWAY
Coast Guard Station
A LANE
OCEAN BEACH
GILGO
West Gilgo Beach
SUFFOLK CO
E2,170,000

TOWN OF BABYLON HARD CLAM RESOURCE STUDY
1991
BASIC STATISTICS

PARAMETER	WATER	MEAN DENSITY	STANDARD DEVIATION
Total Clams	Certified	3.61	2.26
	Uncertified	4.40	3.02
Seed Clams	Certified	1.12	1.06
	Uncertified	0.53	0.68
Littleneck	Certified	1.09	0.95
	Uncertified	0.83	0.95
Cherrystone	Certified	0.61	0.66
	Uncertified	1.10	1.05
Chowder	Certified	0.79	1.03
	Uncertified	1.94	1.76
Mud Crabs	Certified	5.87	6.66
	Uncertified	2.91	4.39
Other Predators	Certified	0.26	0.56
	Uncertified	0.39	0.14
Dead Clams	Certified	0.21	0.39
	Uncertified	0.24	0.47

TOWN OF BABYLON HARD CLAM RESOURE STUDY
1991

STANDING CROP ESTIMATE

NUMBER OF CLAMS*

SIZE/CLASS	CERTIFIED	UNCERTIFIED
Total Clams	91,526,300 ± 17,539,300	67,663,400 ± 14,575,800
Seed	28,396,000 ± 8,226,400	8,150,400 ± 3,282,000
Littleneck	27,635,400 ± 7,372,700	12,763,800 ± 4,585,100
Cherrystone	15,465,700 ± 5,122,100	16,915,900 ± 5,067,700
Chowder	20,029,300 ± 7,993,600	29,833,400 ± 8,494,500

STANDING CROP ESTIMATE

BUSHELS

SIZE/CLASS	CERTIFIED	UNCERTIFIED
Total Clams	192,300 ± 36,900	142,200 ± 30,600
Seed	63,100 ± 18,300	18,100 ± 7,300
Littleneck	61,400 ± 16,400	28,400 ± 10,200
Cherrystone	61,900 ± 20,500	67,700 ± 20,300
Chowder	80,100 ± 32,000	198,900 ± 56,600

* Note that these standing crops are based on revised certified/uncertified acreage, necessitated by additional closures by New York State.

TOWN OF BABYLON HARD CLAM RESOURCE STUDY

Significance Test for Differences in Mean Densities Between 1990-1991

PARAMETER	1990 $\bar{X}$	1991 $\bar{X}$	$\Delta \bar{X}$	Significant @ 95%	Significant @ 99%	Significant @ 99.7%
Total Live Clams						
Certified	3.56	3.61	0.05	No	No	No
Uncertified	3.06	4.40	1.34	Yes	No	No
Seed						
Certified	1.26	1.12	0.14	No	No	No
Uncertified	0.08	0.53	0.45	Yes	Yes	Yes
Littleneck						
Certified	0.91	1.09	0.18	No	No	No
Uncertified	0.80	0.83	0.03	No	No	No
Cherrystone						
Certified	0.55	0.61	0.06	No	No	No
Uncertified	0.78	1.10	0.32	No	No	No
Chowder						
Certified	0.84	0.79	0.05	No	No	No
Uncertified	1.42	1.94	0.52	No	No	No
Dead Clams						
Certified	0.65	0.21	0.44	Yes	Yes	No
Uncertified	0.34	0.24	0.10	No	No	No
Mud Crabs						
Certified	7.80	5.87	1.93	No	No	No
Uncertified	4.88	2.91	1.97	No	No	No
Other Predators						
Certified	0.10	0.26	0.16	No	No	No
Uncertified	0.00	0.39	0.39	Yes	Yes	Yes

TOWN OF BABYLON HARD CLAM RESOURCE STUDY

Significance Test for Differences in Mean Densities
Between Certified and Uncertified Waters 1991

CLASS	Certified $\bar{X}$	Uncertified $\bar{X}$	$\Delta \bar{X}$	Significant @ 95%	Significant @ 99%	Significant @ 99.7%
Total Live Clams	3.61	4.40	0.79	No	No	No
Seed	1.12	0.53	0.59	Yes	Yes	No
Littleneck	1.09	0.83	0.26	No	No	No
Cherrystone	0.61	1.10	0.49	Yes	No	No
Chowder	0.79	1.94	1.15	Yes	Yes	Yes
Dead Clams	0.21	0.24	0.03	No	No	No
Mud Crabs	5.87	2.91	2.96	Yes	No	No
Other Predators	0.26	0.39	0.13	No	No	No

TOWN OF BABYLON HARD CLAM RESOURCE STUDY

Significance Test for Differences Between 1990-1991 Proportions of Total Sampled Population

CLASS	1990 %	1991 %	%	Significant @ 95%	Significant @ 99%	Significant @ 99.7%
Seed	21.4	20.8	0.6	No	No	No
Littleneck	25.7	24.1	1.6	No	No	No
Cherrystone	19.7	21.3	1.6	No	No	No
Chowder	33.2	33.8	0.6	No	No	No

TOWN OF BABYLON - HARD CLAM STUDY (1991)
SUMMARY OF SAMPLE DATA

STATION NUMBER	NORTH LATITUDE	WEST LONGITUDE	SEED CLAMS	LITTLENECK CLAMS	CHERRYSTONE CLAMS	CHOWDER CLAMS	MUD CRABS	OTHER PREDATORS	DEAD CLAMS	WATER CERTIFICATION
1	40 39.91	73 16.42	3	7	0	0	15	5	2	CERTIFIED
2	40 39.67	73 15.87	0	3	0	0	20	4	0	CERTIFIED
3	40 39.72	73 16.17	1	3	0	0	21	0	1	CERTIFIED
4	40 39.83	73 17.01	1	1	1	0	4	0	2	CERTIFIED
5	40 39.68	73 16.62	0	2	0	3	21	0	2	CERTIFIED
6	40 39.67	73 17.14	1	2	0	1	43	2	0	CERTIFIED
7	40 40.11	73 16.94	5	2	3	0	0	0	1	CERTIFIED
8	40 40.52	73 17.43	3	2	1	0	0	1	0	UNCERTIFIED
9	40 40.24	73 17.51	1	1	1	0	0	1	0	CERTIFIED
10	40 39.93	73 17.91	6	7	2	8	6	0	0	CERTIFIED
11	40 39.49	73 17.58	0	3	0	1	6	0	0	CERTIFIED
12	40 39.84	73 17.99	5	3	5	4	12	0	0	CERTIFIED
13	40 39.69	73 18.01	0	2	1	3	29	0	0	CERTIFIED
14	40 39.87	73 18.33	0	5	2	2	18	0	0	CERTIFIED
15	40 39.96	73 19.33	0	2	4	6	2	0	0	CERTIFIED
16	40 40.13	73 17.86	2	1	0	0	0	0	0	CERTIFIED
17	40 40.13	73 17.76	3	0	1	5	1	1	0	CERTIFIED
18	40 39.99	73 17.82	3	6	0	0	8	0	0	CERTIFIED
19	40 39.60	73 17.86	0	2	1	0	6	0	0	CERTIFIED
20	40 39.99	73 17.73	3	4	1	1	6	1	0	CERTIFIED
21	40 39.92	73 17.53	5	4	3	1	9	0	0	CERTIFIED
22	40 40.03	73 17.70	2	1	1	2	9	1	2	CERTIFIED
23	40 40.06	73 17.51	1	1	1	3	6	0	0	CERTIFIED
24	40 40.13	73 17.23	0	1	2	0	2	1	0	CERTIFIED
25	40 40.08	73 17.72	3	2	2	0	9	1	1	CERTIFIED
26	40 40.11	73 17.78	1	0	0	1	11	0	0	CERTIFIED
27	40 40.08	73 17.84	3	0	0	0	4	0	3	CERTIFIED
28	40 40.05	73 17.90	1	2	1	0	55	0	0	CERTIFIED

TOWN OF BABYLON - HARD CLAM STUDY (1991)
SUMMARY OF SAMPLE DATA

STATION NUMBER	NORTH LATITUDE	WEST LONGITUDE	SEED CLAMS	LITTLENECK CLAMS	CHERRYSTONE CLAMS	CHOWDER CLAMS	MUD CRABS	OTHER PREDATORS	DEAD CLAMS	WATER CERTIFICATION
29	40 40.03	73 18.01	3	3	0	0	4	0	1	CERTIFIED
30	40 40.10	73 17.95	3	2	1	0	3	0	0	CERTIFIED
31	40 40.13	73 17.91	7	0	0	3	5	0	0	CERTIFIED
32	40 40.19	73 17.92	0	0	0	0	0	0	0	CERTIFIED
33	40 40.14	73 18.04	2	1	3	6	0	0	0	CERTIFIED
34	40 40.17	73 17.71	3	1	3	4	0	3	0	CERTIFIED
35	40 40.15	73 17.58	6	0	2	0	12	1	0	CERTIFIED
36	40 40.13	73 19.73	2	4	4	8	2	0	0	UNCERTIFIED
37	40 40.13	73 19.85	0	1	2	2	3	0	0	UNCERTIFIED
38	40 40.15	73 19.91	0	1	1	1	0	0	0	UNCERTIFIED
39	40 40.05	73 19.91	2	2	4	10	0	0	4	UNCERTIFIED
40	40 40.03	73 19.92	1	1	1	7	1	0	0	UNCERTIFIED
41	40 40.01	73 19.91	1	0	2	9	6	0	0	UNCERTIFIED
42	40 39.97	73 20.02	3	0	1	3	6	0	0	UNCERTIFIED
43	40 39.98	73 20.08	1	3	2	5	1	0	0	UNCERTIFIED
44	40 40.01	73 20.01	1	3	3	1	1	0	2	UNCERTIFIED
45	40 40.10	73 20.05	0	0	2	3	0	0	1	UNCERTIFIED
46	40 40.67	73 18.02	2	2	0	1	7	0	0	UNCERTIFIED
47	40 40.81	73 18.56	0	0	1	3	4	1	0	UNCERTIFIED
48	40 40.23	73 18.61	5	3	4	1	21	0	1	UNCERTIFIED
49	40 40.60	73 18.64	0	1	0	4	0	1	0	UNCERTIFIED
50	40 40.57	73 19.03	1	2	3	1	15	0	1	UNCERTIFIED
51	40 40.29	73 19.07	0	4	4	7	0	0	0	UNCERTIFIED
52	40 40.17	73 19.46	3	3	3	11	7	0	0	UNCERTIFIED
53	40 40.67	73 19.44	0	10	8	1	4	0	0	UNCERTIFIED
54	40 40.80	73 19.40	0	3	0	2	1	0	2	UNCERTIFIED
55	40 40.18	73 18.13	4	2	1	1	1	0	0	UNCERTIFIED
56	40 39.66	73 19.06	0	4	2	1	46	0	0	CERTIFIED

TOWN OF BABYLON - HARD CLAM STUDY (1991)
SUMMARY OF SAMPLE DATA

STATION NUMBER	NORTH LATITUDE	WEST LONGITUDE	SEED CLAMS	LITTLENECK CLAMS	CHERRYSTONE CLAMS	CHOWDER CLAMS	MUD CRABS	OTHER PREDATORS	DEAD CLAMS	WATER CERTIFICATION
57	40 39.91	73 19.08	5	0	1	4	12	0	0	CERTIFIED
58	40 39.41	73 19.32	0	4	0	2	11	0	1	CERTIFIED
59	40 39.69	73 19.49	0	0	0	0	3	0	0	CERTIFIED
60	40 39.86	73 20.02	2	3	3	10	8	0	0	UNCERTIFIED
61	40 40.21	73 20.02	0	0	0	0	3	0	3	UNCERTIFIED
62	40 40.13	73 20.37	0	0	0	1	5	0	1	UNCERTIFIED
63	40 39.52	73 19.95	5	3	1	3	19	0	0	CERTIFIED
64	40 39.26	73 19.97	2	4	3	0	38	0	1	CERTIFIED
65	40 38.86	73 19.91	6	0	0	1	3	0	0	CERTIFIED
66	40 39.26	73 20.31	1	0	1	2	41	0	0	UNCERTIFIED
67	49 39.53	73 20.33	1	0	0	3	2	0	0	UNCERTIFIED
68	40 39.80	73 20.38	0	0	0	11	3	0	0	UNCERTIFIED
69	40 39.67	73 20.72	4	3	5	10	27	0	0	UNCERTIFIED
70	40 39.55	73 20.82	0	2	2	3	11	0	1	UNCERTIFIED
71	40 39.24	73 22.49	0	0	1	2	3	0	0	UNCERTIFIED
72	40 39.53	73 21.42	1	1	1	2	4	0	0	UNCERTIFIED
73	40 39.89	73 21.12	0	1	1	0	2	0	2	UNCERTIFIED
74	40 39.84	73 21.30	0	0	4	2	0	0	0	UNCERTIFIED
75	40 39.62	73 22.07	0	1	0	0	1	0	0	UNCERTIFIED
76	40 39.53	73 22.48	0	4	5	9	0	0	1	UNCERTIFIED
77	40 39.34	73 22.26	1	1	3	6	25	0	0	UNCERTIFIED
78	40 39.42	73 21.86	0	1	1	1	5	0	0	UNCERTIFIED
79	40 39.54	73 21.43	0	0	1	4	1	0	0	UNCERTIFIED
80	40 39.61	73 21.11	2	1	2	7	6	0	0	UNCERTIFIED

New York State Department of Environmental Conservation
Building 40—SUNY, Stony Brook, New York 11790-2356

Thomas C. Jorling
Commissioner

Mr. Brian Zitani
Bay Management Specialist
Department of Environmental Control
281 Phelps Lane
N. Babylon, NY 11703

September 14, 1992

Dear Brian:

This letter is meant to reiterate the Department's request for the management of the Town of Babylon's leased lots in East Gilgo for the protection of existing tidal wetland species.

The type of management strategy adopted will depend on the limits of existing wetland species and legitimate fire prevention concerns. As I have identified them, three management zones exist (see the attached typical plan diagram). They are:

1. The part of the property landward (south) of a buffer strip five (5) feet north of the norther boundary of the existing 1992 single family dwelling: This area may be mowed at will by the lease holder.

2. The area north of the five foot wide buffer strip to a line parallel to and 200' north of the existing East Gilgo access road: This area will be mowed once a year in August by, or supervised by, Town personnel. Grass species, *Spartina patens*, *Phragmites sp.* and other tidal wetlands species will be mowed to a minimum height of two (2) feet. *Baccharis halimifolia* and other wetland shrubs or bushes will not be cut.

3. The area north of the designated line (200' north of the East Gilgo access road): There shall be no mowing or other disturbance to the natural vegetation or topography in this area at any time.

August was chosen as the one-time mowing month to reduce the risk of fire damage from dry senescing plant stalks, especially *Phragmites sp.*. It was also hoped that cutting *Phragmites sp.* when most to the season's food reserves are still stored in the aerial portion of the plant would reduce the plants' future vigor.

New York State Department of Environmental Conservation
Building 40—SUNY, Stony Brook, New York 11790-2356

Thomas C. Jorling
Commissioner

However, the flowering period for S. patens is late June to October. Cutting of S. patens in August could upset the natural flowering process and propagation and natural variation of the species through seed development and dispersion. If mowing in August is determined by both Town and State personnel to be having a negative impact on the viability of S. patens or other tidal wetland species, then the State will request that the mowing month be changed to November.

If you would like to meet to discuss this most recent proposal please call at your earliest convenience; 751-8468. Thank you, Ron, Raoul, and Gil for all your help and cooperation.

Sincerely,
Kevin R. Du Bois

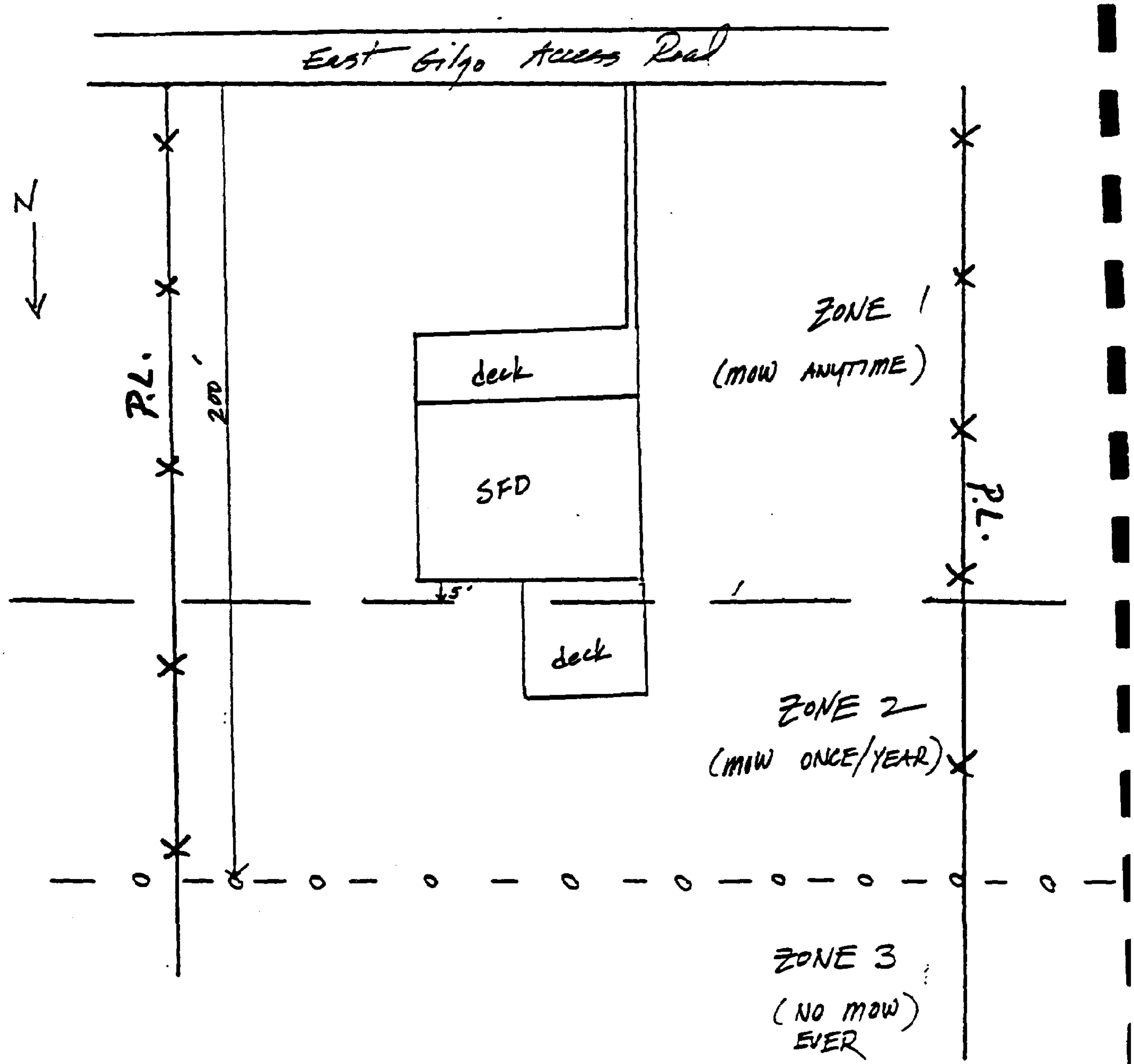
Kevin R. Du Bois
Marine Resource Specialist

KDB
cc: Raoul Castaneda, Deputy Commissioner, Babylon DEC
Ron Kluesener, Executive Assistant to the Commissioner, Town of Babylon DEC
Gil Hanse, Babylon Town Fire Marshall

New York State Department of Environmental Conservation
Building 40—SUNY, Stony Brook, New York 11790-2356

Thomas C. Jorling
Commissioner

* not to scale



APPENDIX E

WEST GILGO BEACH

West Gilgo Beach Assn

RENT RIDER

Year Commencing January 1	Annual Rent	Date of Payment	Method of Payment
1991	$ 398		
1992	$ 545		
1993	$ 693		
1994	$ 840		
1995	$ 988		
1996	$1,135		
1997	$1,283		
1998	$1,430		
1999	$1,578		
2000	$1,725		
2001	$1,873		
2002	$2,020		
2003	$2,168		
2004	$2,315		
2005	$2,463		
2006	$2,610		
2007	$2,758		
2008	$2,905		
2009	$3,053		
2010	$3,200		
2011	$3,200		
2012	$3,200		
2013	$3,200		
2014	$3,200		
2015	$3,200		
2016	$3,600		
2017	$3,600		
2018	$3,600		
2019	$3,600		
2020	$3,600		
2021	$4,000		
2022	$4,000		
2023	$4,000		
2024	$4,000		
2025	$4,000		
2026	$4,400		
2027	$4,400		
2028	$4,400		
2029	$4,400		
2030	$4,400		
2031	$4,800		
2032	$4,800		
2033	$4,800		
2034	$4,800		
2035	$4,800		
2036	$5,300		
2037	$5,300		
2038	$5,300		
2039	$5,300		
2040	$5,300		
2041	$5,800		
2042	$5,800		
2043	$5,800		
2044	$5,800		
2045	$5,800		
2046	$6,400		
2047	$6,400		
2048	$6,400		
2049	$6,400		
2050	$6,400		

GILGO BEACH WEST

Gilgo Beach West
– NORTH LOTS

RENT RIDER

Year Commencing January 1	Annual Rent	Date of Payment	Method of Payment
1991	$ 659.		
1992	$ 792.		
1993	$ 926.		
1994	$1,059.		
1995	$1,193.		
1996	$1,326.		
1997	$1,460.		
1998	$1,593.		
1999	$1,727.		
2000	$1,860.		
2001	$2,994.		
2002	$2,127.		
2003	$2,261.		
2004	$2,394.		
2005	$2,528.		
2006	$2,661.		
2007	$2,795.		
2008	$2,928.		
2009	$3,062.		
2010	$3,200.		
2011	$3,200		
2012	$3,200		
2013	$3,200		
2014	$3,200		
2015	$3,200		
2016	$3,600		
2017	$3,600		
2018	$3,600		
2019	$3,600		
2020	$3,600		
2021	$4,000		
2022	$4,000		
2023	$4,000		
2024	$4,000		
2025	$4,000		
2026	$4,400		
2027	$4,400		
2028	$4,400		
2029	$4,400		
2030	$4,400		
2031	$4,800		
2032	$4,800		
2033	$4,800		
2034	$4,800		
2035	$4,800		
2036	$5,300		
2037	$5,300		
2038	$5,300		
2039	$5,300		
2040	$5,300		
2041	$5,800		
2042	$5,800		
2043	$5,800		
2044	$5,800		
2045	$5,800		
2046	$6,400		
2047	$6,400		
2048	$6,400		
2049	$6,400		
2050	$6,400		

GILGO BEACH WEST - South Lots

Gilgo Beach West A

RENT RIDER

Year Commencing January 1	Annual Rent	Date of Payment	Method of Payment
1991	$ 730.		
1992	$ 860.		
1993	$ 990.		
1994	$1,120.		
1995	$1,250.		
1996	$1,380.		
1997	$1,510.		
1998	$1,640.		
1999	$1,770.		
2000	$1,900.		
2001	$2,030.		
2002	$2,160.		
2003	$2,290.		
2004	$2,420.		
2005	$2,550.		
2006	$2,680.		
2007	$2,810.		
2008	$2,940.		
2009	$3,070.		
2010	$3,200.		
2011	$3,200		
2012	$3,200		
2013	$3,200		
2014	$3,200		
2015	$3,200		
2016	$3,600		
2017	$3,600		
2018	$3,600		
2019	$3,600		
2020	$3,600		
2021	$4,000		
2022	$4,000		
2023	$4,000		
2024	$4,000		
2025	$4,000		
2026	$4,400		
2027	$4,400		
2028	$4,400		
2029	$4,400		
2030	$4,400		
2031	$4,800		
2032	$4,800		
2033	$4,800		
2034	$4,800		
2035	$4,800		
2036	$5,300		
2037	$5,300		
2038	$5,300		
2039	$5,300		
2040	$5,300		
2041	$5,800		
2042	$5,800		
2043	$5,800		
2044	$5,800		
2045	$5,800		
2046	$6,400		
2047	$6,400		
2048	$6,400		
2049	$6,400		
2050	$6,400		

GILGO BEACH EAST

Gilgo Beach

RENT RIDER

Year Commencing January 1	Annual Rent	Date of Payment	Method of Payment
1991	$ 493.		
1992	$ 635.		
1993	$ 778.		
1994	$ 920.		
1995	$1,063.		
1996	$1,205.		
1997	$1,348.		
1998	$1,490.		
1999	$1,633.		
2000	$1,775.		
2001	$1,918.		
2002	$2,060.		
2003	$2,203.		
2004	$2,345.		
2005	$2,488.		
2006	$2,630.		
2007	$2,773.		
2008	$2,915.		
2009	$3,058.		
2010	$3,200.		
2011	$3,200		
2012	$3,200		
2013	$3,200		
2014	$3,200		
2015	$3,200		
2016	$3,600		
2017	$3,600		
2018	$3,600		
2019	$3,600		
2020	$3,600		
2021	$4,000		
2022	$4,000		
2023	$4,000		
2024	$4,000		
2025	$4,000		
2026	$4,400		
2027	$4,400		
2028	$4,400		
2029	$4,400		
2030	$4,400		
2031	$4,800		
2032	$4,800		
2033	$4,800		
2034	$4,800		
2035	$4,800		
2036	$5,300		
2037	$5,300		
2038	$5,300		
2039	$5,300		
2040	$5,300		
2041	$5,800		
2042	$5,800		
2043	$5,800		
2044	$5,800		
2045	$5,800		
2046	$6,400		
2047	$6,400		
2048	$6,400		
2049	$6,400		
2050	$6,400		

OAK ISLAND

RENT RIDER

Year Commencing January 1	Annual Rent
1991	$ 293.75
1992	362.50
1993	431.25
1994	500.00
1995	568.75
1996	637.50
1997	706.25
1998	775.00
1999	843.75
2000	912.50
2001	981.25
2002	1,050.00
2003	1,118.75
2004	1,187.50
2005	1,256.25
2006	1,325.00
2007	1,393.75
2008	1,462.50
2009	1,531.25
2010	1,600.00
2011	1,600.00
2012	1,600.00
2013	1,600.00
2014	1,600.00
2015	1,600.00
2016	1,800.00
2017	1,800.00
2018	1,800.00
2019	1,800.00
2020	1,800.00
2021	2,000.00
2022	2,000.00
2023	2,000.00
2024	2,000.00
2025	2,000.00
2026	2,200.00
2027	2,200.00
2028	2,200.00
2029	2,200.00
2030	2,200.00
2031	2,400.00
2032	2,400.00
2033	2,400.00
2034	2,400.00
2035	2,400.00
2036	2,650.00
2037	2,650.00
2038	2,650.00
2039	2,650.00
2040	2,650.00
2041	2,900.00
2042	2,900.00
2043	2,900.00
2044	2,900.00
2045	2,900.00
2046	3,200.00
2047	3,200.00
2048	3,200.00
2049	3,200.00
2050	3,200.00

OAK BEACH

Oak Beach

RENT RIDER

Year Commencing January 1	Annual Rent	Date of Payment	Method of Payment
1991	$ 516.		
1992	$ 658.		
1993	$ 799.		
1994	$ 941.		
1995	$1,082.		
1996	$1,224.		
1997	$1,365.		
1998	$1,507.		
1999	$1,648.		
2000	$1,790.		
2001	$1,931.		
2002	$2,073.		
2003	$2,214.		
2004	$2,366.		
2005	$2,497.		
2006	$2,639.		
2007	$2,780.		
2008	$2,922.		
2009	$3,063.		
2010	$3,200.		
2011	$3,200		
2012	$3,200		
2013	$3,200		
2014	$3,200		
2015	$3,200		
2016	$3,600		
2017	$3,600		
2018	$3,600		
2019	$3,600		
2020	$3,600		
2021	$4,000		
2022	$4,000		
2023	$4,000		
2024	$4,000		
2025	$4,000		
2026	$4,400		
2027	$4,400		
2028	$4,400		
2029	$4,400		
2030	$4,400		
2031	$4,800		
2032	$4,800		
2033	$4,800		
2034	$4,800		
2035	$4,800		
2036	$5,300		
2037	$5,300		
2038	$5,300		
2039	$5,300		
2040	$5,300		
2041	$5,800		
2042	$5,800		
2043	$5,800		
2044	$5,800		
2045	$5,800		
2046	$6,400		
2047	$6,400		
2048	$6,400		
2049	$6,400		
2050	$6,400		

OAK BEACH ASSOCIATION Oak Island Beach Assoc

RENT RIDER

mencing ary 1	Annual Rent	Date of Payment	Method of Payment
1991	$ 398		
1992	$ 545		
1993	$ 693		
1994	$ 840		
1995	$ 988		
1996	$1,135		
1997	$1,283		
1998	$1,430		
1999	$1,578		
2000	$1,725		
2001	$1,873		
2002	$2,020		
2003	$2,168		
2004	$2,315		
2005	$2,463		
2006	$2,610		
2007	$2,758		
2008	$2,905		
2009	$3,053		
2010	$3,200		
2011	$3,200		
2012	$3,200		
2013	$3,200		
2014	$3,200		
2015	$3,200		
2016	$3,600		
2017	$3,600		
2018	$3,600		
2019	$3,600		
2020	$3,600		
2021	$4,000		
2022	$4,000		
2023	$4,000		
2024	$4,000		
2025	$4,000		
2026	$4,400		
2027	$4,400		
2028	$4,400		
2029	$4,400		
2030	$4,400		
2031	$4,800		
2032	$4,800		
2033	$4,800		
2034	$4,800		
2035	$4,800		
2036	$5,300		
2037	$5,300		
2038	$5,300		
2039	$5,300		
2040	$5,300		
2041	$5,800		
2042	$5,800		
2043	$5,800		
2044	$5,800		
2045	$5,800		
2046	$6,400		
2047	$6,400		
2048	$6,400		
2049	$6,400		
2050	$6,400		

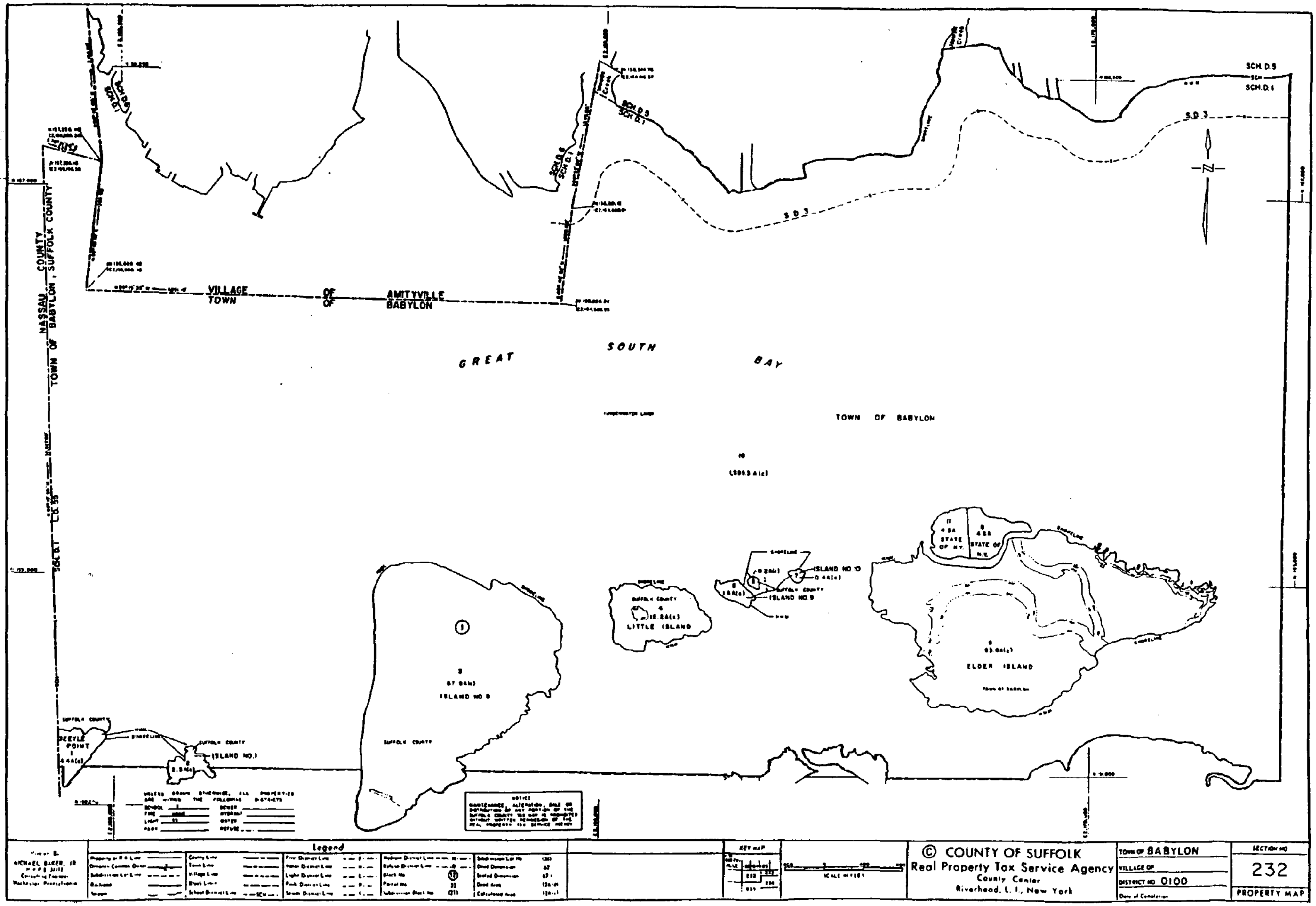
+ the Common Land

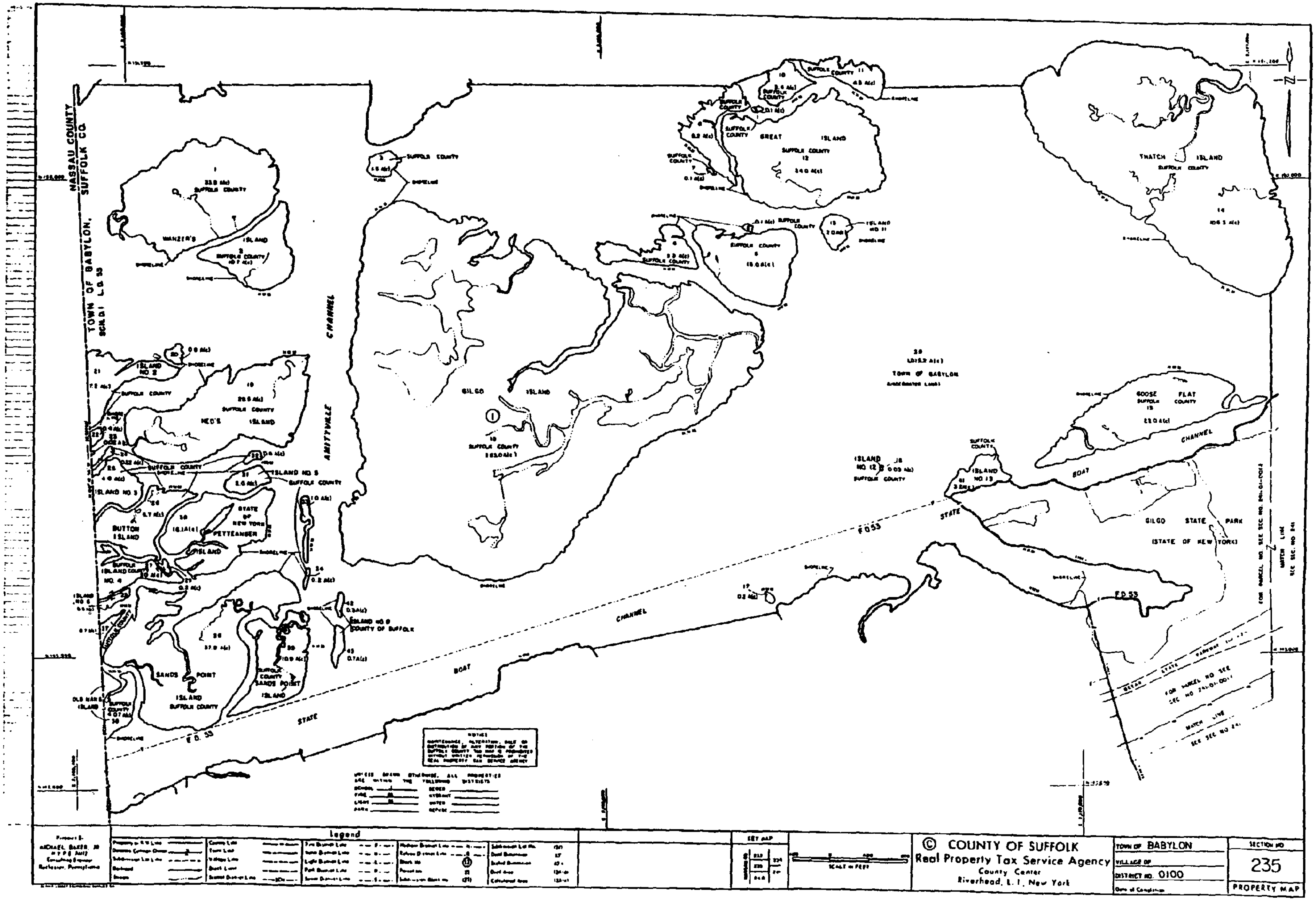
Captree

CAPTREE ISLAND

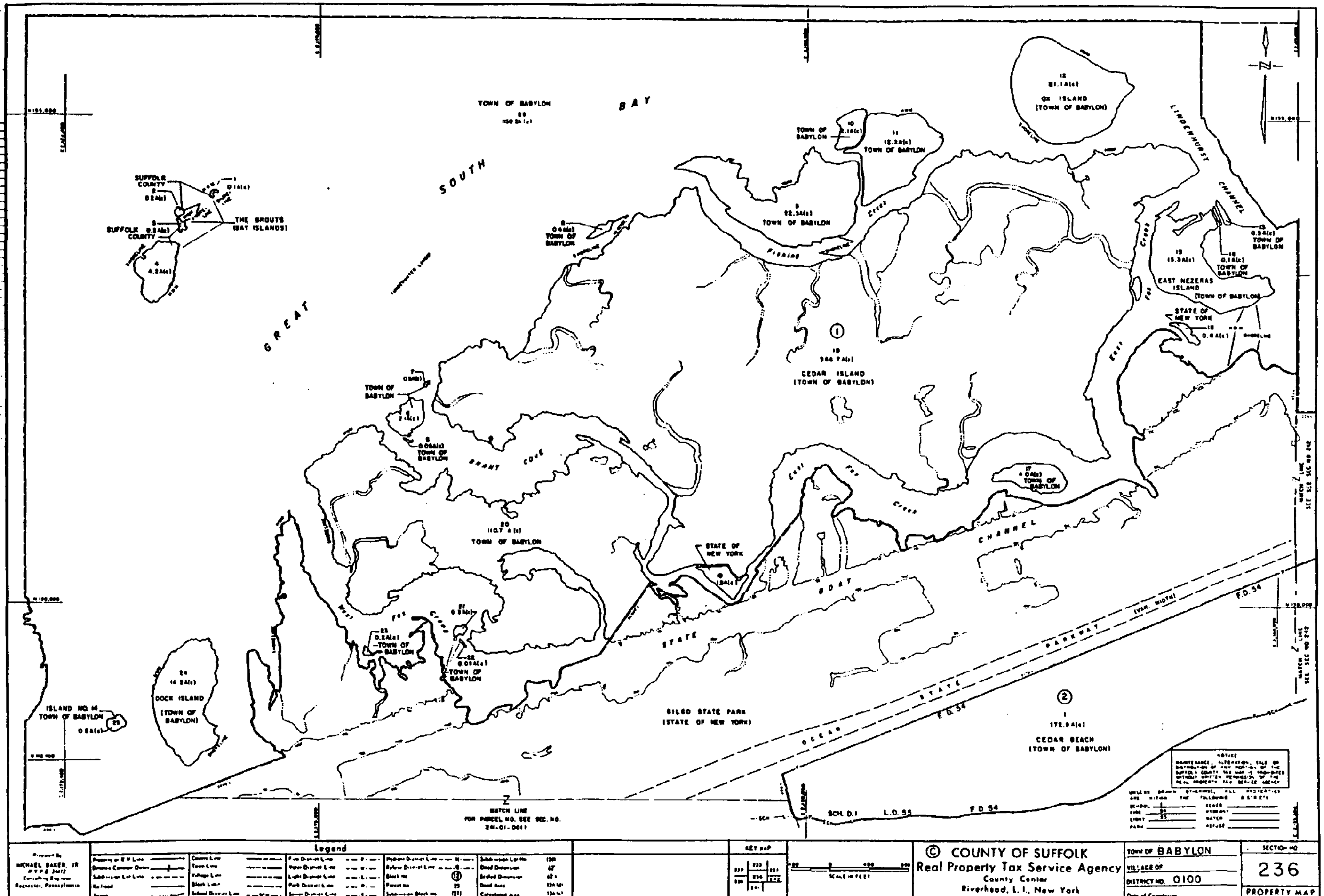
RENT RIDER

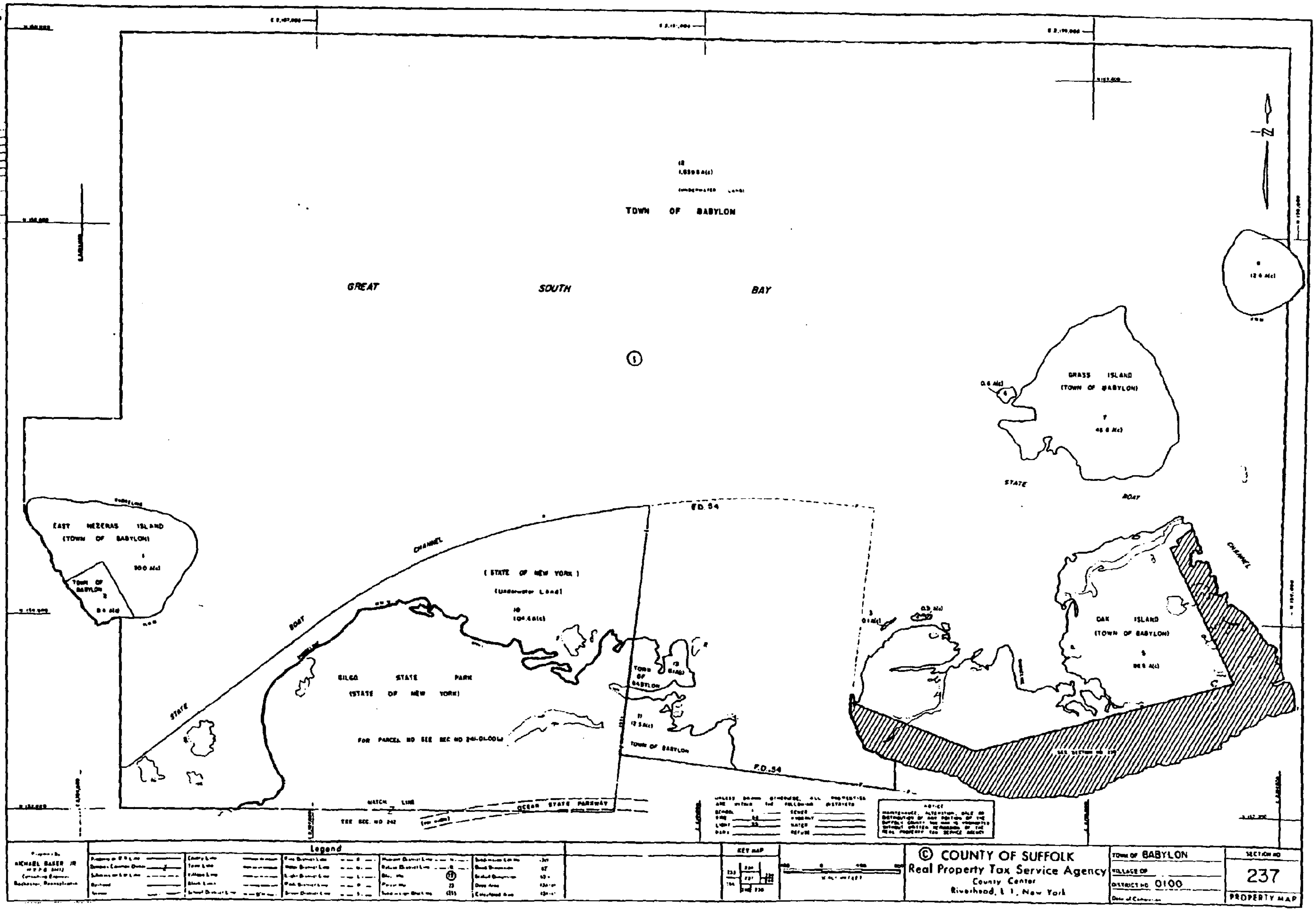
Year Commencing January 1	Annual Rent	Date of Payment	Method of Payment
1991	$ 398		
1992	$ 545		
1993	$ 693		
1994	$ 840		
1995	$ 988		
1996	$1,135		
1997	$1,283		
1998	$1,430		
1999	$1,578		
2000	$1,725		
2001	$1,873		
2002	$2,020		
2003	$2,168		
2004	$2,315		
2005	$2,463		
2006	$2,610		
2007	$2,758		
2008	$2,905		
2009	$3,053		
2010	$3,200		
2011	$3,200		
2012	$3,200		
2013	$3,200		
2014	$3,200		
2015	$3,200		
2016	$3,600		
2017	$3,600		
2018	$3,600		
2019	$3,600		
2020	$3,600		
2021	$4,000		
2022	$4,000		
2023	$4,000		
2024	$4,000		
2025	$4,000		
2026	$4,400		
2027	$4,400		
2028	$4,400		
2029	$4,400		
2030	$4,400		
2031	$4,800		
2032	$4,800		
2033	$4,800		
2034	$4,800		
2035	$4,800		
2036	$5,300		
2037	$5,300		
2038	$5,300		
2039	$5,300		
2040	$5,300		
2041	$5,800		
2042	$5,800		
2043	$5,800		
2044	$5,800		
2045	$5,800		
2046	$6,400		
2047	$6,400		
2048	$6,400		
2049	$6,400		
2050	$6,400		

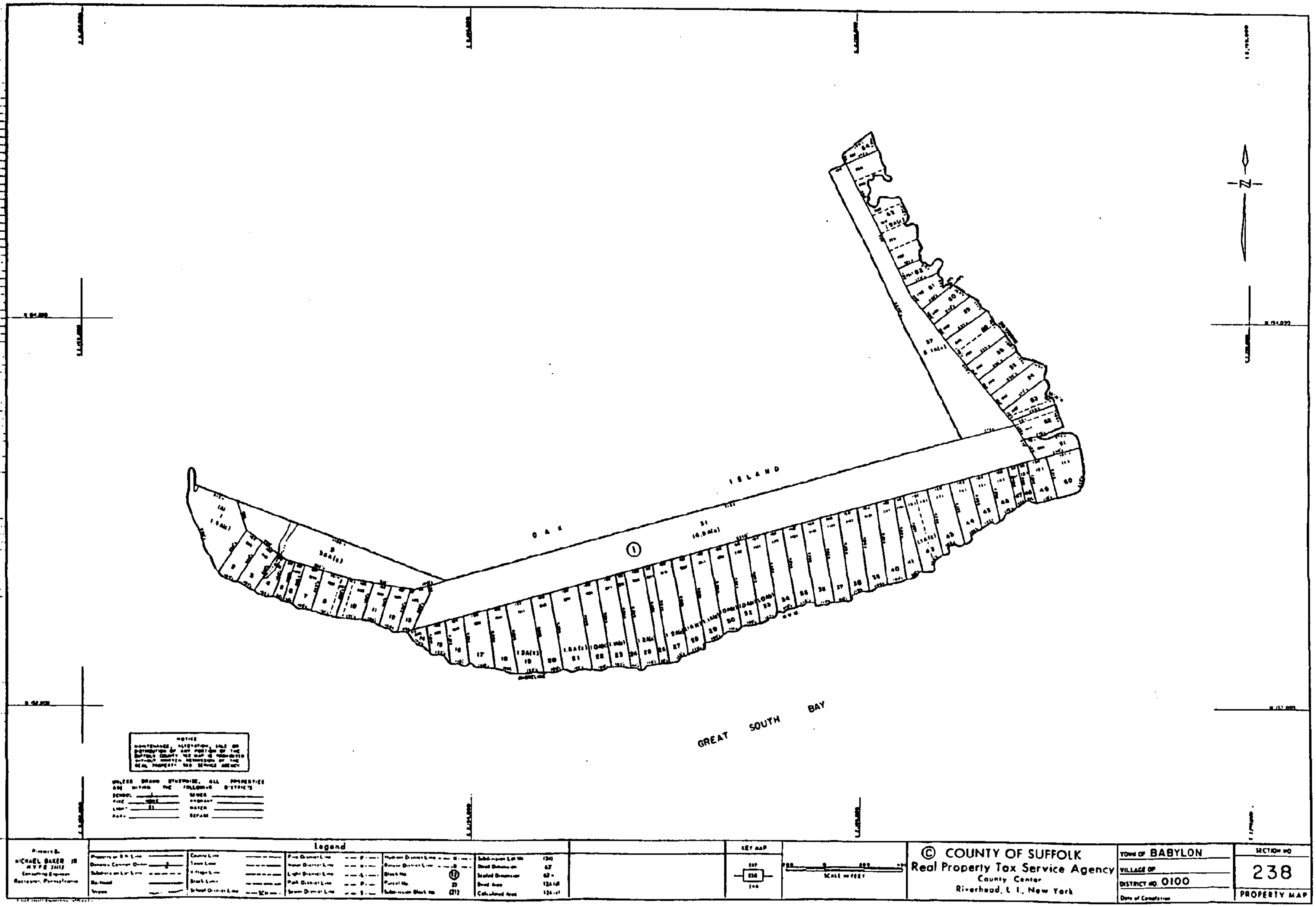

SCH.D.5
SCH.D.1
S.D.3
N
VILLAGE OF AMITYVILLE
TOWN OF BABYLON
NASSAU COUNTY
TOWN OF BABYLON, SUFFOLK COUNTY
GREAT SOUTH BAY
TOWN OF BABYLON
ISLAND NO.10
ISLAND NO.9
LITTLE ISLAND
SUFFOLK COUNTY
ELDER ISLAND
STATE OF N.Y.
ISLAND NO.8
ISLAND NO.1
SHORELINE
Legend
© COUNTY OF SUFFOLK
Real Property Tax Service Agency
County Center
Riverhead, L.I., New York
TOWN OF BABYLON
VILLAGE OF
DISTRICT NO 0100
SECTION NO
232
PROPERTY MAP

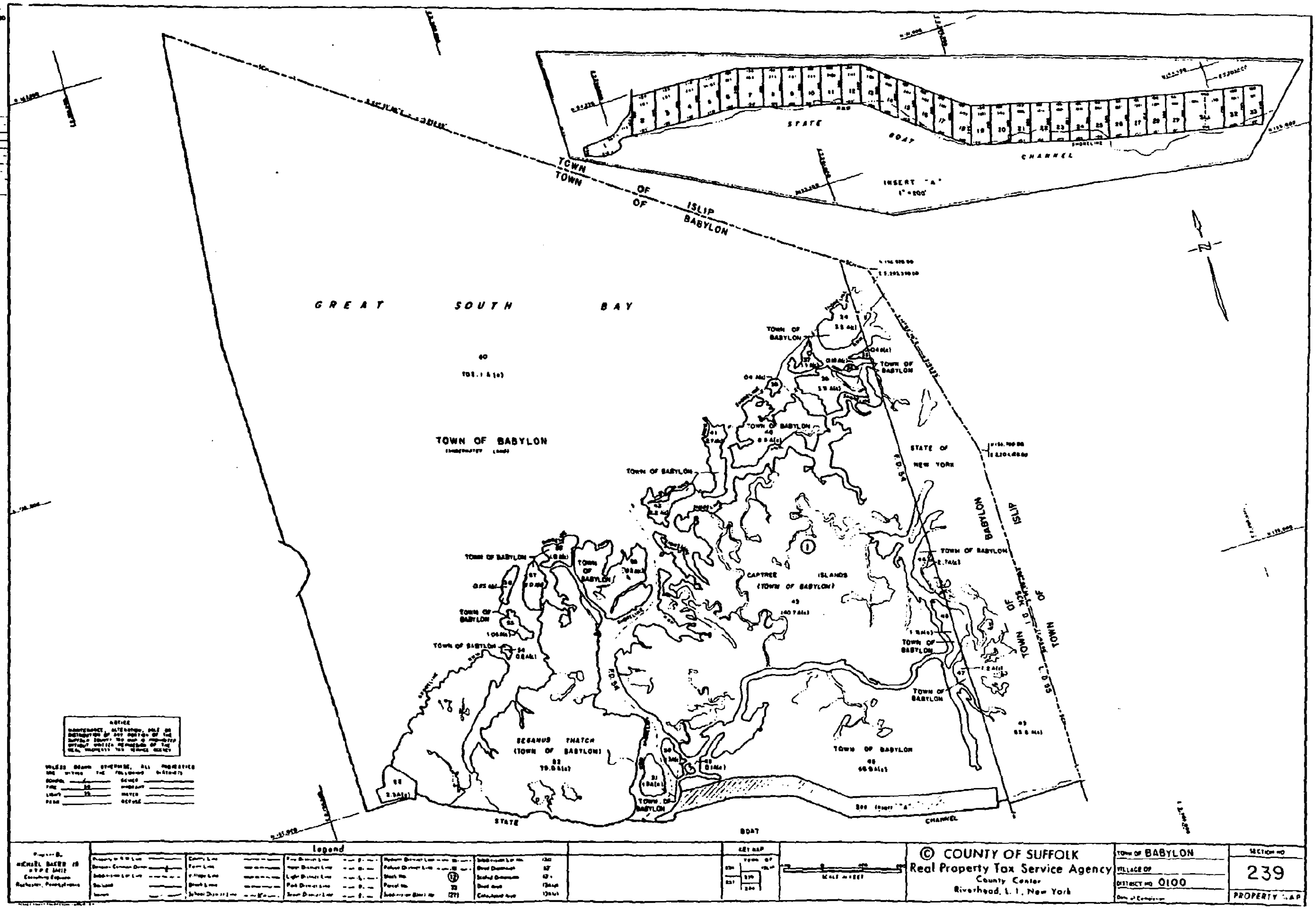


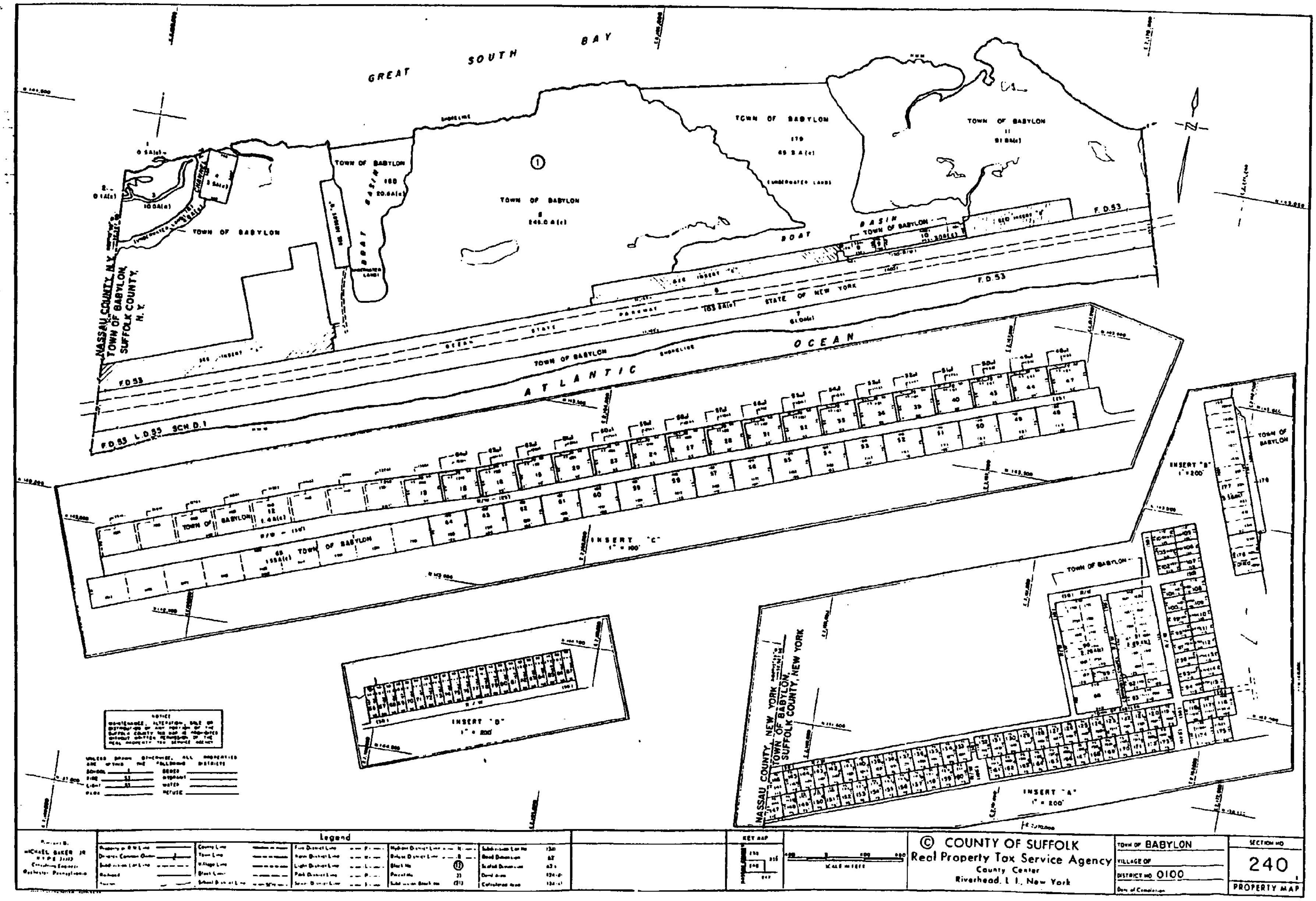
NASSAU COUNTY
SUFFOLK CO.
TOWN OF BABYLON,
SCH.D.1 L.D. 53
WANZER'S ISLAND
SUFFOLK COUNTY
NED'S ISLAND
GILGO ISLAND
SUFFOLK COUNTY
GREAT ISLAND
THATCH ISLAND
AMITYVILLE CHANNEL
ISLAND NO 2
ISLAND NO 3
ISLAND NO 5
ISLAND NO 11
ISLAND NO 12
ISLAND NO 13
BUTTON ISLAND
PETTEANGER ISLAND
STATE OF NEW YORK
SANDS POINT ISLAND
SANDS POINT ISLAND
ISLAND NO 9 COUNTY OF SUFFOLK
OLD MAN'S ISLAND
TOWN OF BABYLON
GOOSE FLAT
BOAT CHANNEL
GILGO STATE PARK
(STATE OF NEW YORK)
STATE BOAT CHANNEL
F.D. 53
SHORELINE
Legend
© COUNTY OF SUFFOLK
Real Property Tax Service Agency
County Center
Riverhead, L.I., New York
TOWN OF BABYLON
VILLAGE OF
DISTRICT NO. 0100
SECTION NO
235
PROPERTY MAP

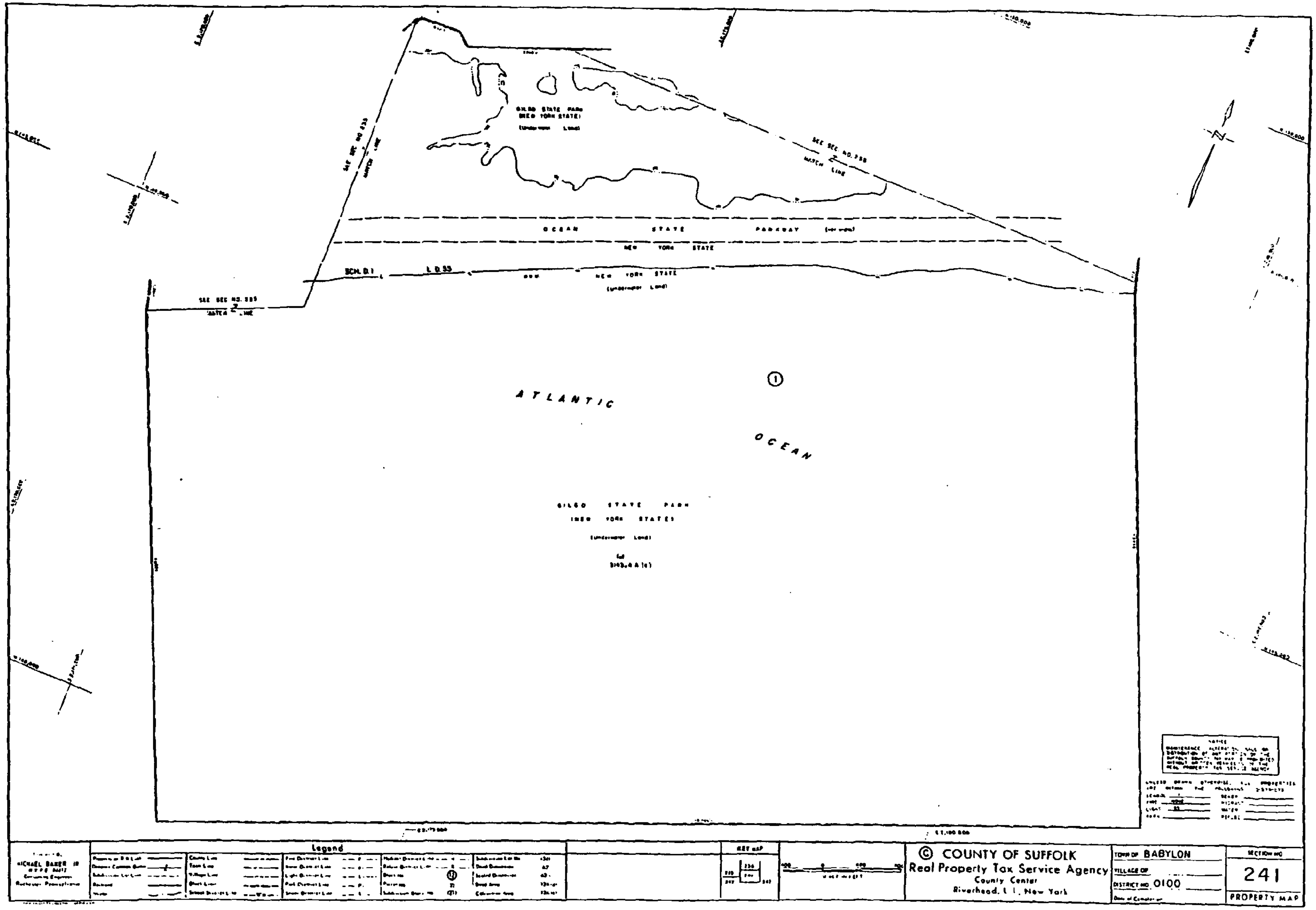

GREAT SOUTH BAY
TOWN OF BABYLON
LINDENHURST CHANNEL
OX ISLAND (TOWN OF BABYLON)
EAST NEZERAS ISLAND (TOWN OF BABYLON)
STATE OF NEW YORK
CEDAR ISLAND (TOWN OF BABYLON)
THE GROUTS (BAT ISLANDS)
SUFFOLK COUNTY
BRANT COVE
Fishing Creek
East Fox Creek
West Fox Creek
DOCK ISLAND (TOWN OF BABYLON)
ISLAND NO. 14 TOWN OF BABYLON
GILGO STATE PARK (STATE OF NEW YORK)
CEDAR BEACH (TOWN OF BABYLON)
STATE BOAT CHANNEL
OCEAN STATE PARKWAY
F.D. 54
L.D. 55
SCH. D. 1
MATCH LINE FOR PARCEL NO. SEE SEC. NO. 241-01-0011
Legend
© COUNTY OF SUFFOLK
Real Property Tax Service Agency
County Center
Riverhead, L. I., New York
TOWN OF BABYLON
DISTRICT NO. 0100
SECTION NO.
236
PROPERTY MAP

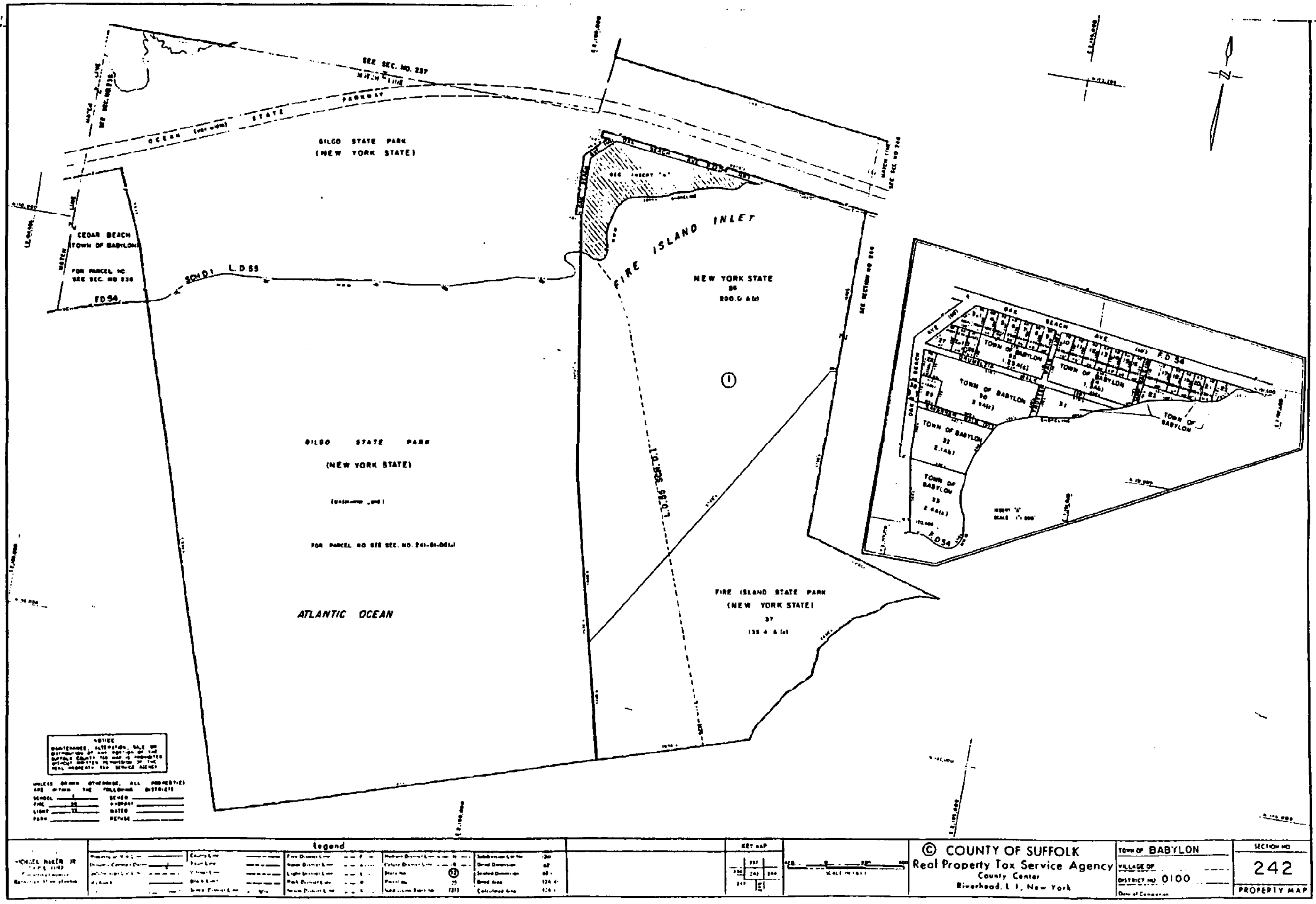

GREAT SOUTH BAY
TOWN OF BABYLON
12 1,0598A(c) UNDERWATER LAND
1
EAST MEZERAS ISLAND (TOWN OF BABYLON)
1 30.0 A(c)
TOWN OF BABYLON 2 8.4 A(c)
GRASS ISLAND (TOWN OF BABYLON)
7 46.8 A(c)
6 0.6 A(c)
8 12.6 A(c)
OAK ISLAND (TOWN OF BABYLON)
5 96.5 A(c)
0.3 A(c)
3 0.1 A(c)
STATE BOAT CHANNEL
(STATE OF NEW YORK) (Underwater Land)
10 104.6 A(c)
GILGO STATE PARK (STATE OF NEW YORK)
FOR PARCEL NO SEE SEC NO 241-01-001
TOWN OF BABYLON 13 6.8 A(c)
11 12.5 A(c)
TOWN OF BABYLON
F.D. 54
OCEAN STATE PARKWAY
MATCH LINE
SEE SEC. NO 242
SEE SECTION NO. 239
Legend
KEY MAP
© COUNTY OF SUFFOLK
Real Property Tax Service Agency
County Center
Riverhead, L.I., New York
TOWN OF BABYLON
VILLAGE OF
DISTRICT NO 0100
SECTION NO
237
PROPERTY MAP


OAK ISLAND
GREAT SOUTH BAY
N
© COUNTY OF SUFFOLK
Real Property Tax Service Agency
County Center
Riverhead, L. I., New York
TOWN OF BABYLON
VILLAGE OF
DISTRICT NO. 0100
SECTION NO.
238
PROPERTY MAP
Legend
KEY MAP
SCALE IN FEET

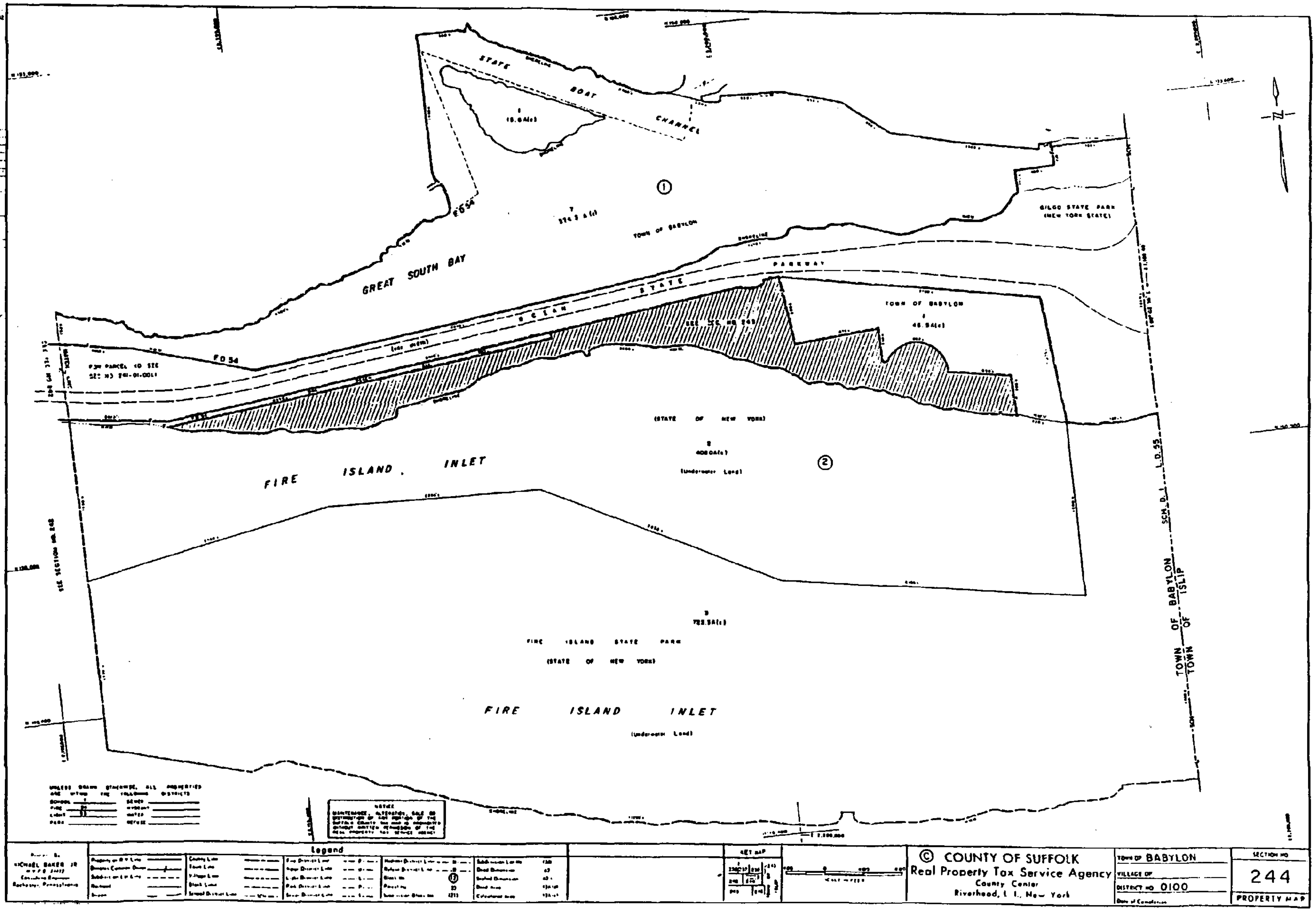

GREAT SOUTH BAY
TOWN OF BABYLON
TOWN OF ISLIP
TOWN OF BABYLON
STATE OF NEW YORK
CAPTREE ISLANDS
(TOWN OF BABYLON)
SEGANUS THATCH
(TOWN OF BABYLON)
STATE BOAT CHANNEL
INSERT "A"
1" = 200'
Legend
© COUNTY OF SUFFOLK
Real Property Tax Service Agency
County Center
Riverhead, L. I., New York
TOWN OF BABYLON
VILLAGE OF
DISTRICT NO 0100
SECTION NO
239
PROPERTY MAP

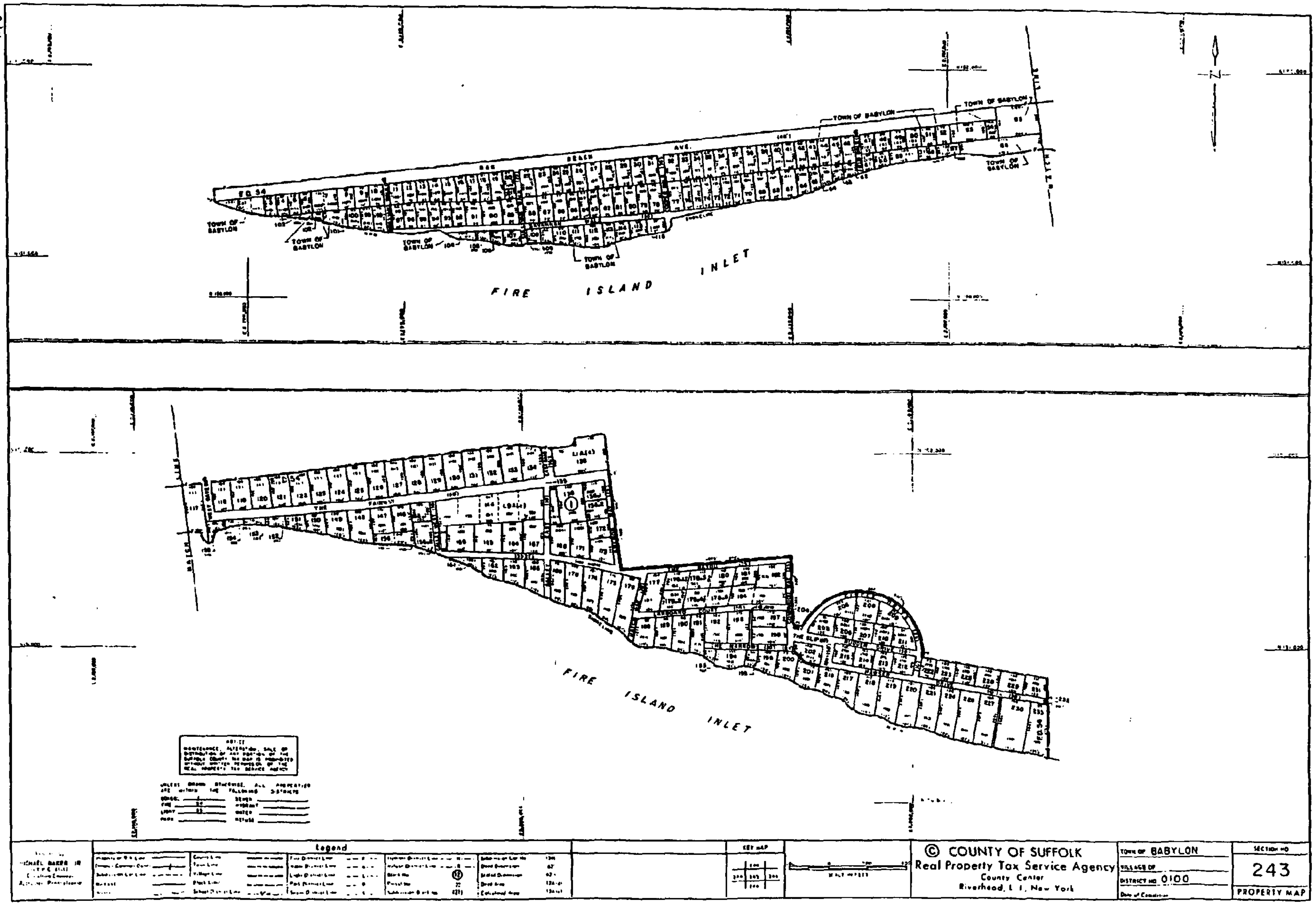

GREAT SOUTH BAY
ATLANTIC OCEAN
TOWN OF BABYLON
BOAT BASIN
STATE OF NEW YORK
F.D.53
F.D.53 L.D.55 SCH.D.1
NASSAU COUNTY, N.Y.
TOWN OF BABYLON, SUFFOLK COUNTY, N.Y.
INSERT "A" 1" = 200'
INSERT "B" 1" = 200'
INSERT "C" 1" = 100'
INSERT "D" 1" = 200'
NASSAU COUNTY, NEW YORK
TOWN OF BABYLON, SUFFOLK COUNTY, NEW YORK
Legend
KEY MAP
© COUNTY OF SUFFOLK
Real Property Tax Service Agency
County Center
Riverhead, L.I., New York
TOWN OF BABYLON
VILLAGE OF
DISTRICT NO 0100
SECTION NO
240
PROPERTY MAP


GILGO STATE PARK
(NEW YORK STATE)
(Underwater Land)
OCEAN STATE PARKWAY
NEW YORK STATE
SCH. D. 1
L. D. 33
NEW YORK STATE
(Underwater Land)
SEE SEC. NO. 235
MATCH LINE
SEE SEC. NO. 238
MATCH LINE
ATLANTIC OCEAN
1
GILGO STATE PARK
(NEW YORK STATE)
(Underwater Land)
Legend
KEY MAP
© COUNTY OF SUFFOLK
Real Property Tax Service Agency
County Center
Riverhead, L. I., New York
TOWN OF BABYLON
VILLAGE OF
DISTRICT NO. 0100
SECTION NO.
241
PROPERTY MAP



SEE SEC. NO. 237
PARKWAY
OCEAN STATE
GILGO STATE PARK
(NEW YORK STATE)
CEDAR BEACH
TOWN OF BABYLON
FOR PARCEL NO. SEE SEC. NO 238
F.D.54
SCH.D.1 L.D.55
GILGO STATE PARK
(NEW YORK STATE)
FOR PARCEL NO SEE SEC. NO. 241-01-001
ATLANTIC OCEAN
FIRE ISLAND INLET
NEW YORK STATE
36
200.0 A(d)
1
L.D.55 SCH.D.1
FIRE ISLAND STATE PARK
(NEW YORK STATE)
37
OAK BEACH AVE
F.D.54
TOWN OF BABYLON
TOWN OF BABYLON
30
TOWN OF BABYLON
32
TOWN OF BABYLON
33
F.D.54
TOWN OF BABYLON
Legend
© COUNTY OF SUFFOLK
Real Property Tax Service Agency
County Center
Riverhead, L.I., New York
TOWN OF BABYLON
VILLAGE OF
DISTRICT NO. 0100
SECTION NO.
242
PROPERTY MAP


STATE BOAT CHANNEL
GREAT SOUTH BAY
TOWN OF BABYLON
GILGO STATE PARK (NEW YORK STATE)
OCEAN STATE PARKWAY
SEE SEC NO 245
TOWN OF BABYLON
(STATE OF NEW YORK)
(Underwater Land)
FIRE ISLAND INLET
FIRE ISLAND STATE PARK
(STATE OF NEW YORK)
FIRE ISLAND INLET
(Underwater Land)
SEE SECTION NO. 248
TOWN OF BABYLON
TOWN OF ISLIP
SCH. D. 1 L.D. 55
Legend
© COUNTY OF SUFFOLK
Real Property Tax Service Agency
County Center
Riverhead, L. I., New York
TOWN OF BABYLON
DISTRICT NO 0100
SECTION NO
244
PROPERTY MAP



FIRE ISLAND INLET
TOWN OF BABYLON
BAR BEACH AVE.
THE FAIRWAY
FIRE ISLAND INLET
Legend
© COUNTY OF SUFFOLK
Real Property Tax Service Agency
County Center
Riverhead, L. I., New York
TOWN OF BABYLON
DISTRICT NO. 0100
SECTION NO.
243
PROPERTY MAP

LOT DESIGNATIONS

WEST GILGO BEACH ASSOCIATION - 80 UNITS - PLATE 3A

BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.	BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.
1	94	188	28	121	53
2	95	187	29	122	52
3	96	186	30	125	49
4	97	185	31	126	48
5	98	184	32	127	47
6	99	183	33	128	46
7	100	182	34	129	45
8	101	181	35	130	44
9	102	193	36	131	43
10	103	195	37	132	42
11	104	197	38	133	28
12	105	198	39	134	27
13	106	196	40	135	26
14	107	194	41	136	25
15	108	180	42	137	24
16	109	179	43	138	23
17	110	178	44	139	22
18	111	177	45	140	21
19	112	176	46	141	20
20	113	175	47	142	19
21	114	174	48	143	18
22	115	173	49	144	17
23	116	192A	50	145	16
24	117	191	51	146	15
25	118	189	52	147	14
26	119	55	53	148	13

BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.	BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.
27	120	54	54	149	12
55	150	11	68	163	39
56	151	10	69	164	38
57	152	9	70	165	37
58	153	8	71	166	36
59	154	7	72	167	35
60	155	6	73	168	34
61	156	5	74	169	33
62	157	4	75	170	32
63	158	3	76	171	31
64	159	2	77	172	30
65	160	1	78	173	29
66	161	41	79	174	190
67	162	40	80	175	192

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T.O.B. = Town of Babylon

GILGO BEACH - 57 UNITS - PLATE 3B

BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.	BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.
1	13	36	30	59	23
2	15	34	31	60	25
3	16	32	32	61	27
4	19	30	33	62	29
5	20	28	34	63	31
6	23	26	35	64	33
7	24	24	36	66	A
8	27	22	37	67	B
9	28	20	38	68	C
10	31	18	39	69	D
11	32	16	40	70	E
12	35	14	41	71	F
13	36	12	42	72	G
14	39	10	43	73	H
15	40	8	44	74	I
16	43	6	45	75	J
17	44	4	46	76	K
18	47	2	47	77	L
19	48	1	48	78	M
20	49	3	49	79	N
21	50	5	50	80	O
22	51	7	51	81	P
23	52	9	52	82	Q
24	53	11	53	83	R
25	54	13	54	84	S
26	55	15	55	85	T
27	56	17	56	86	U
28	57	19	57	87	V
29	58	21			

OAK ISLAND - 54 UNITS
GREAT SOUTH BAY ISLES ASSOCIATION - PLATE 3C

BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.	BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.
1	2	97	28	30	20
2	3	96	29	32	19
3	4	95	30	33	18
4	5	94 (B)	31	34	17
5	6	94 (A)	32	36	15
6	7	93	33	37	14
7	8	92	34	38	13
8	10	40	35	39	12
9	11	39	36	40	11
10	12	38	37	41	10
11	13	37	38	42	9
12	14	36	39	43	7
13	15	35	40	44	6
14	16	34	41	45	5
15	17	33	42	46	4
16	18	32	43	47	3
17	19	31	44	49	2
18	20	30	45	50	1
19	21	29	46	51	59
20	22	28	47	52	41
21	23	27	48	53	42
22	24	26	49	54	43
23	25	25	50	56	45
24	26	24	51	59	50
25	27	23	52	60	51
26	28	22	53	61	52
27	29	21	54	64	58

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OAK BEACH WEST - 24 UNITS - PLATE 3E

BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.
1	38	306
2	29	305
3	28	304
4	27	255
5	3.1	253
6	4	252
7	5	251
8	6	250
9	7	249
10	8	248
11	9	247A
12	10	246A
13	11	245A
14	12	244A
15	13	243A
16	14	242A
17	15	241A
18	16	240A
19	17	238A
20	18	225A
21	19	224A
22	21	223A
23	21	222A
24	22	221A

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OAK BEACH EAST - 96 UNITS - PLATE 3F

BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.	BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.
1	2.1	114	30	32	25
2	3	113	31	33	24
3	4	112	32	34	23
4	5	111	33	35	22
5	6	110	34	36	21
6	8	107	35	37	20
7	9	106	36	38	19
8	10	105	37	39	18
9	11	86	38	40	17
10	12	85	39	41	16
11	13	84	40	42	15
12	14	83	41	43	14
13	15	82	42	45	12
14	16	81	43	46	11
15	17	80	44	47	6
16	18	79	45	48	5
17	19	78	46	60	9
18	21	77	47	61	10
19	20	77 (A)	48	62	26
20	22	56	49	63	27
21	23	55	50	64	28
22	24	54	51	65	29
23	25	53	52	66	30
24	26	52	53	67	31
25	27	51	54	68	32
26	28	50	55	69	33
27	29	49	56	70	34
28	30	48	57	71	35
29	31	47	58	72	36

BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.	BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.
59	73	37	78	92	90
60	74	38	79	93	91
61	75	39	80	94	92
62	76	40	81	95	93
63	77	41	82	96	94
64	78	57	83	97	95
65	79	58	84	98	115
66	80	59	85	99	116
67	81	60	86	100	117
68	82	61	87	105	98
69	83	62	88	106	97
70	84	63	89	107	96
71	85	64	90	108	76
72	86	65	91	109	75
73	87	66	92	110	74
74	88	67	93	112	72
75	89	87	94	114	70
76	90	88	95	115	69
77	91	89	96	116	68

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OAK ISLAND BEACH ASSOCIATION - 72 UNITS - PLATE 3G

BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.	BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.
1	118	2	29	170	99
2	119	3	30	174	47
3	121	5	31	175	49
4	125	9	32	176	50
5	127	11	33	177	51 (A)
6	129	13	34	178.2	53
7	131	15	35	178.4	55
8	133	17	36	182	67
9	134	18	37	197	68
10	135	GATE KEEPER	38	188	51 (B)
11	136.1	100	39	189	60
12	138	48	40	190	61
13	172	102	41	191	57
14	171	103	42	192	58
15	168	104	43	194	63
16	167	38	44	196	59
17	164	37	45	198	70
18	163	36	46	199	84
19	160	35	47	200	85
20	158.2	41	48	201	86
21	146	28	49	216	87
22	147	27	50	217	88
23	149	25	51	218	89
24	150	24	52	202	71
25	151	23	53	215	73
26	162	44	54	214	74
27	165	45	55	213	751
28	169	98	56	205	111

BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.	BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.
57	208	112	65	227	95
58	209	113	66	230	96
59	211	106	67	233	97
60	212	76	68	231	82
61	220	91	69	229	81
62	221	92	70	228	80
63	224	93	71	225	79
64	226	94	72	223	78

CAPTREE ISLAND - 32 UNITS - PLATE 3D

BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.	BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.
1	1	1	17	17	16
2	2	2	18	18	17
3	3	3	19	19	18
4	4	4	20	20	19
5	5	4A	21	21	20
6	6	5	22	22	21
7	7	6	23	23	22
8	8	7	24	24	23
9	9	8	25	25	24
10	10	9	26	26	25
11	11	10	27	27	26
12	12	11	28	28	27
13	13	12	29	29	28
14	14	13	30	31.1	30
15	15	14	31	32	31
16	16	15	32	33	32

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CAPTREE ISLAND - 32 UNITS - PLATE 3D

BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.	BUILDING NO.	SCTM LOT NO.	T.O.B. LOT NO.
1	1	1	17	17	16
2	2	2	18	18	17
3	3	3	19	19	18
4	4	4	20	20	19
5	5	4A	21	21	20
6	6	5	22	22	21
7	7	6	23	23	22
8	8	7	24	24	23
9	9	8	25	25	24
10	10	9	26	26	25
11	11	10	27	27	26
12	12	11	28	28	27
13	13	12	29	29	28
14	14	13	30	31.1	30
15	15	14	31	32	31
16	16	15	32	33	32

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